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SPECIAL ARTICLE

HOW TO GET AND KEEP COMPETENT HEALTH OFFICERS.

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THE half has not been told about the health officer, and what has been said is not true. The problem in relation to the health officer can be pithily put in the characterization of the Scotchman who said, when speaking of his countryman: "You canna tell wha' you can do wi a Scotchman a' you catch him yung." So it is with the health officer—you cannot tell what you may make of him if you catch him young, not more than from five to seven years out of the medical school, and preferably less than thirty years of age. The trouble with the present health officer is that he is not prepared for his position; he just falls into it, and he never knows quite how long he is going to stay.

In approaching the problem of the selection of a health officer, it must be conceded that he must be drawn from the ranks of the medical profession, and that he must be a physician with special training in sanitation and hygiene. It is his duty to teach people about the preservation of health, and the prevention of disease. What training for such a career

has he had in the medical schools with their limited curricula of courses in sanitation and hygiene? The great profession of medicine, in the past, based its teachings, and still bases them, on the old principle of the cure of disease; while the new profession of medicine, the profession of medicine that we hope for, the one that will get a new grip upon the thinking men and women who make the opinions of the world, will have to recast some of the methods of the old medicine, and recast its teachings into a new form which will emphasize the prevention of disease.

The men taught in the older schools of medicine still think about the sick; the men taught in the schools to be will think about the well. All the schools of medicine that have sought to acquire leadership in the healing art have based their teachings upon those of Hippocrates, Galen, and their followers, and out of superstition, witchcraft, and medieval soothsaying, have sought the cure of disease. All the succeeding practices, from botanic medicine to osteopathy and Eddyism, have been but protests against the therapeutics of the schools. But while the medical schools still retain much of the old therapeutics, and their teaching is still concerned with the healing of the sick, out of the teaching of the schools and among the men so taught, you will have to find your health officer and train him—and you will have to catch him young.

What qualities, then, are desirable in the health officer? Not only must he be a man of robust physique, with a body the ready servant of the will, but he must have the ability to teach the truths of the new medicine. His knowledge of that science must be firmly grounded upon the fundamental principles of physics, chemistry, and biology, and also upon the interrelation between the life processes of the simple forms of plant and animal life, and the higher life—the life of man. He must not only comprehend these truths, but he must be able to teach them to individuals and to groups. He must know not only the history of his own department of knowledge, but he must know the history of civilization. He must have what the Germans call *Erdkunde*. "He must know the earth, what is in it, on it, around it." He must know, too, the history of man,—how he has passed from the simple life of hunter, fisher and herder, to the complex life, and from field and farm to factory and office, so that he may teach people that as they change their modes of living and go from the country to the cities, new modes of living become necessary and new practices absolutely essential to health.

To the health officer the solution of problems relating to ventilation, water supply, plumbing, drainage, sewerage, the removal of wastes, ashes, garbage and rubbish, the removal of dust, the prevention of noise, provision for housing, prevention of congestion, the production, transportation,

and preparation of food, the principles of diagnosis, the prevention of disease, the systematic collection and interpretation of the data pertaining to causes of death—of which we know little—and the gathering together of accurate knowledge concerning the causes of sickness—of which we know less—these, and many other associated problems, must all be his for solution. He must early recognize that there is an old sanitation as well as an old medicine, and that in the old sanitation there are objects of fetich worship, such as sewer gas, disinfection, and quarantine, with other analogies, anachronisms, and superstitions, that must disappear and give place to newer, more modern, less harmful, less expensive and less restrictive practices, based on the newer teachings of the great masters of modern hygiene and sanitary science.

One of the chief criticisms of the present, directed at the health officer as well as at the health office, is that both he and it have no simple, concrete program of public health to present to the medical profession and to the people. One health officer says to the profession and the public: "Pasteurize all milk." Another says: "Away with pasteurization, it's a fraud." One says: "All the persons in the house with a case of contagious disease must be absolutely quarantined." Another says: "All quarantines are folly." One says: "Disinfect after every contagious disease." Another says: "Disinfection is a survival of the practice of the middle ages." One says: "All plumbing must be tested by the peppermint or smoke test; all houses must have their plumbing trapped, and all traps must be ventilated through the roof and at the sidewalk." Another says: "All but fixture traps are unnecessary, and back vents are but devices of the plumber to sell pipe. Better back vent your children's noses and throat's, and let the plumbing alone."

Just as long as we have such widely divergent views as these, neither the profession nor the public will have much respect for the health officer. The health officer must, therefore, be among those who will help to make a program of public health that will appeal alike to the modern sanitarian, the medical profession, and the public; not a program that will help only to settle those questions of sanitation already referred to, but a program that will also deal clearly and concisely with the questions of preventive medicine as they relate to the child, the care of the expectant mother, the uncared for gap in childhood from birth to the time the child enters school, the institution and conduct of that kind of medical inspection of schools and school nursing that will have to do with the orderly examination and record of the different phases of the physical development of the child. In dealing with the child the health officer must be able to form concepts of what might come to pass in a new order of hygiene and sanitation,

when as much attention will be given to the health and life of the child as we now give to the preservation of the life and health of plants and animals. He must be able to see and provide means so that, under a better condition of health administration, the birth of a child will be safe from the perils that now surround it; he must see clearly and provide means for preventing the menace of gonorrheal blindness at the very threshold of the world; he must see the relation of clean food to the digestive tract; he must view clearly the early dangers of adenoids, and even small tonsils, to health and growth; he must know thoroughly the dangers of infectious diseases to the orderly growth of the organs of the child's body, and their influence on the development of the teeth, the organs of sight and hearing, and their determining causes in lowering weight and stature at given age periods; he must sense with clear vision and sharp insight the relation of children, one to another, in the school and at play, follow the budding sex development, and turn the thought of the child into proper channels as soon as it begins to inquire into the origin of being, and so follow it through the various paths of development, teaching, guarding, directing, and protecting the growth of the child until it becomes a man or a woman.

When you come to select a health officer, consider the problems both sanitary and hygienic that are crying out for solution. Ask the candidates for the position what appears to them to be the principal problems of the city, and their scheme for solving them. Ask each candidate to write an essay discussing these questions and to give his plan of solving them in detail, with the mode of administration and the cost involved. In other words, every applicant should be asked to include in an essay not only a plan for the solution of the public health problems of the city, for which there is immediate and pressing need, but he should outline a program of public health, administrative control, and the cost of such a plan. In this way you will be most likely to discover the man you want for your health officer. Such a man you must have, and such men are today getting the basic foundation of such training in the medical school. It only remains for them to secure such post graduate work, in the laboratories of hygiene and in the schools of social service, as will fit them to learn to practice and to teach the hygiene and sanitation that we desire in present day work.

But the modern health officer, aside from the scientific training in medicine and social service necessary to fit him for the practice of this arduous branch of the new medicine, must be possessed of that executive ability, that enthusiasm and judgment that shall enable him to conduct successfully an office so pregnant with possibilities for the good of his munici-

pality. A man with such training must be willing to serve in an humble capacity for long years, willing to endure, if need be, the clamor of the public; but with all this, he, like the rest of his kind, is human, and you must pay him a living wage and insure him a tenure of office. So far as I am able to discover, you pay him worse than a laborer and treat him like a menial. You unnecessarily interfere with him, and you discharge him with about as much ceremony as you would discharge an ordinary laborer; and yet this is the man to whose care you entrust what you hold dearest on earth—the lives and health of people. This man, on whose skill and judgment you rely for advice and action in times of stress is the man who is usually the poorest paid and the most frequently damned citizen of your city. The worker in other lines has his compensation measured by the results he is able to accomplish, but it is not so with the health officer.

The practice of modern sanitation and hygiene, having for its object the prevention of disease and the prolongation of life, does not lead to increased compensation for the health officer, but, cut off from that increase in private practice which devotion to public duty in America always brings, he lands at the end of his career, out of work, out of money, and out of health. To the city of his service he has usually given the best that is in him, and his labor has been of inestimable value to the life and health of the people of the community; but more than that, if well done, it has been of economic value by lessening the burden which the city has had to bear in caring for the sick, supporting the widowed, the orphaned, and the fatherless, in hospitals and other institutions, through private and public charities. Even more than this, the economic value of his work serves to attract attention to the city as a city of the well; and the advantages of a city where health is high and deaths relatively infrequent will be in the time to come, if not now, more than the advertising advantages of bill boards and newspapers. Our cities are beginning to learn the lesson that our insurance companies are learning, and just as the insurance men have realized that it is better by care to keep their policy holders alive to pay premiums, than it is to let them die and have the companies pay death claims, so our cities are learning that to grow in population and in importance it is not only necessary to attract new citizens, but it is necessary to take care of the health and lives of those they have.

To do all this, and much more, is the work of the new health officer. To do his work well, he will not only have to exercise all the knowledge he has, but he will have constantly to accumulate new knowledge by frequently attending meetings and conventions of sanitary and social workers. He will also have to do a large amount of research work, both directly

and through the labor of those in the laboratory. The equipment of the modern health office, the employment of laboratory workers, and the purchase of apparatus, all cost money, and in the beginning it may be difficult to get all the money necessary to man and equip the various divisions of the department where advanced work should be going on for the solution and interpretation of questions relating to the public health. For the study of cognate subjects, public spirited citizens equip and endow departments in various institutions, and surely no one could place even small sums of money to any better purpose, than for the endowment of special or general work in public health laboratories. Mr. Samuel Hopkins Adams has pointed out that it is the duty of "private philanthropy to point the way to public responsibility"; so I trust, in the future, we may have private help, even for public work, until the time may come when, if cities still pursue their niggardly policy toward the health officer, some private citizen may endow a public health department in the city government, or a chair of public health in the university. Under such conditions, the opportunity to work with a reasonable tenure of office and a fair compensation, the new health officer would become the chief advertiser of your city's health, its wealth, and its progress.

Health Officer, Rochester.

American Public Health Association

SOME OF THE LARGER ASPECTS OF THE WORK OF THE METROPOLITAN SEWERAGE COMMISSION OF NEW YORK.*

By GEORGE SÖPER,
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Two facts must be squarely faced by those whose duty it is to provide for the disposal of municipal waste, whether that waste be solid or liquid:—First, the growth of cities results in the production of constantly increasing quantities of waste; and second, the natural facilities for disposing of this material remain the same, or are actually reduced with the passage of time. The truth of these facts finds abundant illustration in the field of sewage disposal; many rivers and harbors originally able to absorb the sewage which it was convenient to discharge into them, have become offensively polluted and a menace to the public health.

Up to the present time, the cities in the metropolitan district of New York have discharged their sewage, without any restriction, into New York harbor and its immediate tributaries. The result has been that various parts of the harbor, including some of the busiest shipping places, have gradually become foul, and the waters are now black and ill-smelling. The main channels have not yet become excessively polluted, but practically all of the waters of upper New York Bay, and of the East and lower Hudson Rivers, bear unmistakable evidence of sewage

The Metropolitan Sewerage Commission was appointed by the Mayor of New York in accordance with a special act of the New York state legislature. The commission is an engineering board with well-defined powers and duties, created to make a thorough study of the conditions of sewage disposal in the metropolitan district and to formulate a plan for protecting the waters for all time to come.

To persons not familiar with the local conditions, who consider only the great expanse of tidal water available, the need for any other method of sewage disposal than the primitive means which the harbor affords may not be apparent. New York is by no means the first great seaport to feel the need of a system of sanitary conservancy. Boston and the twenty-eight municipilities in its vicinity, have had a metropolitan sewerage commission for years, and have constructed extensive public works for the protection

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

of the tidal waters against pollution by sewage. The City of Providence has long had sewage disposal works. At Baltimore, the question of harbor pollution has passed through the stage of investigation, and the work of constructing a comprehensive sewerage and sewage disposal system is well advanced. In England, a special metropolitan board constructed the large and important system for collecting and purifying the sewage of London. Dublin, Belfast, Glasgow, and Marseilles have constructed engineering works of great magnitude for the protection of their tidal harbors. The number of inland cities situated upon rivers and lakes in various parts of the world which have built, or are considering building, improved sewage disposal works, etc., is large. New York is therefore a follower and not a leader in this matter.

The Metropolitan Sewerage Commission has existed since 1906. In that year, it succeeded the New York Bay Pollution Commission, an honorary body which had been appointed a few years before by the governor of the state to inquire into the sanitary condition of the harbor waters, but found its resources unequal to the undertaking. Two years later, in 1908, the commission was reorganized. It is expected that the commission will go out of existence within three years from the present date. By that time, preliminary plans and estimates will have been made for the public works necessary to divert and purify as much of the sewage as the waters cannot inoffensively and harmlessly absorb. These works will necessarily cost a large sum of money, but it will be the commission's endeavor to keep the cost as low as possible, by utilizing, as far as is consistent with a due regard to public heath and welfare, the absorptive or digestive capacity of the harbor.

The harbor's digestive capacity for sewage is a very interesting question and one which has been made the subject of long, scientific study by the Metropolitan Commission. Aside from this work, the efforts of the commission may be divided into two parts: First, investigations to show the relative condition of the waters in different parts of the harbor with respect to their capacity for sewage, and, second, the formation of a general plan or policy to dispose of the sewage by better means than now exist. In studying the condition of the waters, extensive use has been made of chemical, bacteriological, and microscopical analyses, for which thousands of samples of water have been collected. A steamer was equipped as a floating laboratory so that samples could be examined before their composition could become materially altered. Solid matter from the bottom was collected in all parts of the harbor. Sewage matter was found to exist wherever the currents permitted deposits of any kind to take place.

The commission has found that the movement of tidal water in and out of New York harbor is not an effective means of transporting sewage impurities to sea. In co-operation with the United States Coast and Geodetic Survey, extensive investigations have been made which show that the only movement of water toward the ocean in excess of the movement in the opposite direction consists of the land water which flows down the rivers. At dry seasons this excess is very small. Sea water sometimes flows up the Hudson river for over fifty miles. In consequence of the oscillating movement of the tides, the sewage is carried back and forth indefinitely near the points of discharge. In calm weather solid matter from sewage can be seen floating upon the surface of the water in all parts of New York harbor, and the wind blows the floating refuse to the shores and keeps it there.

In May, 1910, the commission made a full report of its investigations and conclusions. In its report it recommended that an interstate metropolitan sewerage commission be appointed, or, if this was not feasible, that a permanent New York metropolitan sewerage commission be created. It should be the duty of such a commission to exercise supervisory authority over the disposal of sewage in the metropolitan district.

Neither of these recommendations has so far been followed. Instead, the temporary Metropolitan Sewerage Commission of New York has been continued for three years to make plans and estimates for the works which the studies already made show to be necessary. To construct the intercepting sewers and sewage disposal works which doubtless will be required will be a long and costly undertaking.

THE VENTILATION OF EMIGRANT SHIPS.*

By PETER H. BRYCE, M. A., M. D.,
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As the chief officer of a medical inspection service, specifically appointed to examine all the immigrants entering Canada, with the idea of preventing the admission of persons suffering from acute communicable diseases, or from other diseases communicable but less acutely so, such as eye and scalp diseases, and with a view further, to allowing the landing of none not at the moment physically fit to earn a livelihood, my attention was early directed to the conditions existing on shipboard during a voyage, and their relation to outbreaks of disease which from time to time take on the character of an epidemic. During an active experience of over six years, I have naturally formed certain conclusions; one of the most positive of these is that conditions on shipboard in the emigrant quarters of many ships are such as demand radical changes, if very serious injustice to a poor, and, under the circumstances, helpless class of intending citizens of this or other new continents is to be prevented. To illustrate: I recall the S. S. "Montrose," tonnage 4,000, which arrived in Quebec, May 6, 1906, with 1,532 passengers; of these 124 were detained, 64 on account of conjunctivitis and 60 on account of trachoma, or one in every 12 immigrants.

When it is further understood that today at the great British and Continental seaports very complete equipment exists for the housing, inspecting, cleansing, and treating of thousands of emigrants at a time, (5,000 may be housed at Hamburg in suburban premises of many acres in extent, in separate buildings owned and equipped by the Hamburg-American Line) and that for days before arrival at these ports inspection has gone on at the borders and in the interior of Germany, Great Britain, Italy, and other countries, it is apparent that the emigrant going on shipboard at any of these ports today probably represents a higher absolute degree of immunity from disease than would a similar number of persons taken at random in any country in the world. It is evident, therefore, that when such persons have purchased passage on a transatlantic steamship, they have rights which the government of every progressive country should secure to them so far as is consistent with scientific knowledge and the actual practical difficulties of the situation.

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

There has recently been published a very important report on "Steerage Conditions" by the Commission on Immigration appointed under an Act of the United States Congress passed February 20, 1907. The report reads as follows:

"Transatlantic steamers may be classed in three general subdivisions on the basis of their provisions for other than cabin passengers. These are: Vessels having ordinary or old-type steerage, those having the new-type steerage, and those having both. In order to make clear the distinction between these subdivisions, a description of the two, old and new, will be given.

"The old-type steerage is the one whose horrors have been so often described. It is unfortunately still found in *a majority of the vessels* bringing immigrants to the United States. It is still the common steerage in which hundreds of thousands of immigrants form their first conceptions of our country and are prepared to receive their first impressions of it. The universal human needs of space, air, food, sleep, and privacy are recognized to the degree now made compulsory by law. Beyond that the persons carried are looked upon as so much freight, with mere transportation as their only due. The sleeping quarters are large compartments, accommodating as many as 300 or more persons each. . . The berth 6 feet long and 2 feet wide, with 2½ feet of space above it, is all the space in which the steerage passenger can assert a definite right. To this 30 cubic feet of space he must, in a large measure, confine himself. No space is designated for hand baggage. As practically every traveler has some bag or bundle, this must be kept in the berth. . . . At least two large transportation lines furnish the passengers in the steerage eating utensils, and require each one to retain these throughout the voyage. . . . .

"When to this very limited space of much filth and stench is added inadequate means of ventilation, the result is most unendurable. Its harmful effects on health and morals scarcely need be indicated. Two 12-inch ventilator shafts are required for every 50 persons in every room; but the conditions here are abnormal, and these provisions do not suffice. The air was found to be invariably bad, even in the higher enclosed decks where hatchways afford further means of ventilation. . . . . Considering this old-type steerage as a whole, it is a congestion so intense, so injurious to health and morals that there is nothing on land to equal it. That people live in it only temporarily is no justification of its existence. The experience of a single crossing is enough to change bad standards of living to worse. It is abundant opportunity to weaken the body and implant there germs of disease to develop later. . . Legislation, however, may complete what competition began.

"The new-type steerage may again be subdivided into two classes. The best of these follows very closely the plan of the second cabin arrangements; the other in some respects adheres to the old-type steerage. These resemblances are chiefly in the construction of berths and the location and equipment of dining rooms. . . . Staterooms contain from two to eight berths. The floor space between is utilized for hand-baggage. On some steamers special provision is made beyond the end of the berths for baggage. There are hooks for clothes, a seat, a mirror, and sometimes even a stationary washstand and individual towels are furnished. Openings below and above partition walls admit a circulation of air. Lights near the ceiling in the passage-ways give light in the staterooms. In some instances there is an electric bell within easy reach of both upper and lower berths which summons a steward or stewardess in case of need. . . . In spite of the less crowded conditions the air

is still bad. Steamers that were models in other respects were found to have air as foul as the worst. The lower the deck the worse the air. Though bearing no odors of filth, it was heavy and oppressive. It gave the general impression of not being changed nearly often enough."

While it is hardly necessary to say that with the marvellous evolution of naval construction today, whereby a great ocean liner transports its 2,000 or 3,000 human beings 3,000 miles in five or six days, the horrors of ocean voyages are yearly becoming a thing of the past, the quotations already given show how many vessels of the old type still exist with voyages of eight to fourteen days' duration. For instance, during the present year (1910) some 76 vessels have been engaged in bringing immigrants to Canada across the Atlantic, and not more than ten have other than the old-fashioned natural, air-duct ventilation.

In spite of this fact, it is a remarkable commentary on the thoroughness of European inspection that during three months, ending July 31, out of some 80,000 immigrants not more than 400 were detained at Quebec for all diseases not included in the acute contagions. The illustration already given, however, shows what would have happened with perfect certainty, had contagion accidentally been conveyed into the steerage quarters, on any except the largest and best-ventilated ships, if they were crowded as during the spring sailings, or even if they were not crowded. I have learned by personal observation, that when there is not a large number of passengers, two or three compartments only out of eight or nine were used during the voyage for the sake of economy of management.

It is apparent, of course, that no evidence of the serious effects of overcrowding on shipboard during a transatlantic voyage upon the spread of a chronic disease, such as tuberculosis, can be obtained; but we have unfortunately too much evidence of the high mortality from tuberculosis in the navy of different countries to question the extremely serious effects, not only upon the blue jackets, but also upon the 500,000 sailors of different countries who go down to the sea in ships. Thus, in a study of tuberculosis in the U. S. Navy by Surgeon General P. M. Rixey, M. D., in 1908, it is pointed out that for the five years ending in 1906, the German Navy gave a mortality from tuberculosis of 2.4 per 1,000, the British Navy of 3.2 per 1,000, and the U. S. Navy 5.6 per 1,000, or actually 4.9 in the latter during an eleven year period. Dr. Rixey quotes Assistant Surgeon Stitt of the "Wasp," who, after setting forth many of the well-known means by which the dissemination of tuberculosis takes place, goes on to say:

"Anyone who has studied the conditions prevailing on our men-of-war can understand the unfavorable conditions for consumptives when the cubic air space per man frequently falls below 300 cubic feet, and when even if the artificial means of ventilation provides for such deficiency,

proper conditions may not obtain by reason of the tendency to decrease the revolutions of the blower, notably by those in authority, to save coal, etc., but surreptitiously as well, by the men themselves closing valves to mitigate draughts or lessen the noises at night."

In this quotation we have summed up the essential features of the situation, and have fully illustrated its difficulties. That its difficulties have hitherto been and still are great on battleships, has been very admirably set forth in a paper presented at the Army and Navy Section of the meeting of the British Medical Association, held in London last July (1910), by Surgeon L. F. Cope of the Royal Navy, the subject of his paper being "Air and Ventilation in Modern Warships." Surgeon Cope points out that it is none too easy to obtain a constant supply of pure air on a modern warship; that the living space may be taken at about 200 cubic feet per man, that the distribution of air is difficult, and that the blue jacket likes to keep all vents closed. He points out that through a 15½ inch circular port with a hatchway near it, and a difference of 20° F. between the outer and the inner temperature, the air delivery on a calm day gives about 13,000 cubic feet per hour; that is, roughly, enough for four men. He then adds: "It is, however, apparent that when 150 live on a mess deck it is quite impossible to arrange enough ports and hatches to supply them with sufficient air by means of natural ventilation alone."

In modern warships this system has been replaced by fan ventilation. A typical ship of modern type has in all 62 fans ranging in size from 40 in. to 7½ in. in diameter, of which 7 are exhaust and 55 are supply fans. Inlets to the different quarters are provided on the basis of one louvred opening to every 1,000 feet of cubic air space.

Surgeon Cope gives the average of 100 determinations of carbonic acid ($C O_2$) under various conditions with the same average number of men with the following result:

1. Optimum conditions with all scuttles and hatches open and fans running gave everywhere..... 6.6 parts per 1,000 ($C O_2$)
2. With natural ventilation..... 9.0 " " "
3. With artificial ventilation only..... 8.4 " " "
4. With no attempt at supplying fresh air..... 13.0 " " "

It was found that all the living spaces where the men and officers live can be supplied by sirrocco fans 12½ in. diameter, with 4,000 cubic feet of air per minute, and that such an area could be properly ventilated where one fan is placed at each portion of the mess deck and supplied with air by a trunk running down from the upper deck. In winter the air was warmed in chambers with steam coils, but became dried to the disagreeable extent of having only 46% of relative humidity. So far no remedy of this condition has been attempted.

I have given briefly the chief facts in these experiments, first, because they are the first I have seen described anywhere relating to the artificial ventilation of a large modern vessel, and second, because they accord so closely with conclusions I have gradually been arriving at with regard to emigrant ships. Recently I went to Europe on a vessel of the most modern construction fitted up with fan ventilation, consisting of 15 inlet fans and 10 outlet fans. There were six decks, and the fan ventilation was supplied to the lower decks, the upper saloon quarters having natural ventilation. At different times I inspected the vessel with the captain and the ship's medical officer, and it was only in the sailors' quarters that the usual stuffiness was noted, and this was owing to the old habit of the sailors in shutting out fresh air. I returned home from the Continent on a twelve day ship, solely for emigrants, on which I was the only saloon passenger. On this voyage I was officially instructed to study the sanitation of the ship. It was a ship of 4,712 gross tons, with accommodation under British Board of Trade laws, adopted in the Canada Immigration Act, for 1,000 passengers, which number was slightly exceeded in the May voyage. On this voyage nine separate compartments contained emigrants, but with the small number on my trip, the largest number was 88 in 2,417 square feet of deck space, in compartment No. 6. With the legal allowance of 2 x 7½ feet, or 15 square feet of floor space with 7 feet height, the cubic air space of this compartment for each emigrant was about 200 cubic feet, which, on a previous voyage with 143 in the compartment, was reduced to about 100. There were the usual inlet and outlet ducts leading from the deck, with cowls set either towards or from the wind. During the whole voyage there were head winds, so that at from 10 to 11 knots an hour a strong wind was always blowing and the conditions were most favorable for ventilation.

The test apartment, compartment No. 6, held only 88 persons (young men), while its legal capacity was 143 or more. This apartment was on the lower deck, and had a floor space of 2,417 square feet. The ventilating duct was 16 feet long, and of 18 inches diameter; the funnel opening on the deck was 30 inches, with a capacity of 254 square inches, or 1.76 square feet.

June 30—Test No. 1, Wind W. W. & S.

Air velocity per anemometer	2,519 cu. ft. per 5 min.
Air velocity per anemometer	504 per min.
Air supplied per hour	55,696 cu. ft.

Test No. 2 (same day).

Air velocity per anemometer	2,820 per 5 min.
Air velocity per anemometer	564 per min.
Air supplied per hour	59,558 cu. ft.

July 4—Test No. 3, 11 P. M.

Air velocity per anemometer	2,015 per 5 min.
Air velocity per anemometer	403 ft. per min.
Air supplied per hour	42,557 cu. ft.
Air for 88 persons	484 per capita
For complement of 143 persons	297 cu. ft.

July 7—Test No. 4, 4 A. M. Compartment No. 6.

Rate of air flow	2,950 per 5 min.
Velocity	590 per min.
Air supplied per hour	64,304 cu. ft.
Air supplied to 88 persons	732 cu. ft. per hour
Air supplied to 143 persons	452 cu. ft. per hour

July 1—Test of air flow Compartment No. 7 (upper deck).

Area 1,391 sq. ft., capacity 82 persons.

Length of duct 8 ft. inlet 16 in. diameter, area 201 sq. in.

Velocity of flow	886 ft. per min.
Air supplied per hour	53,200 cu. ft.

A study of the tables makes it apparent that the average amount of air actually supplied, taking the two extreme tests, was 608 cubic feet per person per hour, with 88 present, or with the legal complement, 374 cubic feet per hour. During the voyage the polymeter readings for moisture remained between 65 and 75 per cent of relative humidity except on one stormy day.

To illustrate the results of the ventilation a number of tests were made on the carbonic acid present in the air, with the results shown in the tabulation given below. It will be noted that the results were obtained during the summer when the outer air was warm and could be introduced unheated without serious inconvenience, and at a time when the ventilation hoods were specially set into the wind to insure the largest amount of air possible. The tests were made in compartment No. 6, whose area has been given.

The amount of carbonic acid in immigrant quarters (Compartment No. 6):

Normal air contains 3 parts carbonic acid ($C O_2$) in 10,000 parts.

TEST No. 1, 11 P. M.—With apparatus placed between inlet and outlet ventilator.
Amount of carbonic acid, 7.5 parts in 10,000 parts.

TEST No. 2, 11:30 P. M.—With apparatus placed at side of compartment.
Amount of carbonic acid 10 parts in 10,000 parts.

TEST No. 3, 4 A. M.—With apparatus placed same as in Test No. 2.
Amount of carbonic acid, 12 parts in 10,000.

If the estimate be made from these experiments for 143 persons, the number legally admissible to the compartment, the amount of carbonic acid would be proportionately greater per 10,000 parts.

Not only is it made apparent from the table that with the small number, relatively, present and the most favorable weather and wind conditions, the compartment hour by hour became increasingly foul, but a careful estimate made of the accumulating air pollution shows it has also something of a geometrical ratio of progression up to a point where an equilibrium is established between the polluting influence and the fresh air introduced.

But though it is true that the short residence on shipboard in an overcrowded apartment in the stormy weather of the spring, made more foul through seasickness, cannot be productive of the same constitutional evils as continued residence in unventilated quarters, yet the records of immigrant detentions on arrival at our seaports have shown that it is only necessary under such conditions to have a case of infectious disease present in a compartment, such as measles or ophthalmia, in order to have the infection disseminated throughout the whole compartment. Hence it is apparent that in the interests both of the steamship companies and of the emigrants, either one of two methods should be adopted for increasing the amount of fresh air available *per capita* in the sleeping quarters on board ship. These are: Increase of air space per person, or, increase in the amount of fresh air introduced. While the first method may or may not, for financial reasons, always be possible in practice, yet it is certainly possible, by mechanical appliances, to increase very greatly the amount of fresh air driven into a given cubic air space. What is urgently needed is the adoption on the older ships, and indeed even on some of the newer and smaller vessels, of mechanical fan ventilation.

The actual condition of a single ship which arrived in the St. Lawrence this year was as follows:

The ship left Rotterdam on June 13, and arrived at quarantine on the 26th. One case of measles occurring on June 14, was immediately isolated with the members of the family to which it belonged. In the compartment where the case occurred there were 279 individuals, married persons and members of families. The compartment consisted of two decks connected at each end by a small stairway, and these compartments were ventilated by means of these stairways and by a portion of the hatches being left open during fine weather. The beds were set up all around the sides and the eating tables occupied the centre of each deck. On the morning of the 26th (exactly 13 days after exposure on the 13th, when the first rash appeared), several cases of measles were discovered by the ship's surgeon, who continued to find others every hour of the day, until on arrival he reported 21 cases. By 9 P. M. a dozen more were

discovered by the quarantine officer. All the 279 passengers were landed at quarantine. These persons comprised 51 families. Of the number, there were 174 children 18 years and under. The total number of cases was 71. 36 families developed cases; 15 families developed no cases, but the members of these 15 families were all grown up or had had measles recently. It is clear, then, in the condition under which these people were associated in the compartments, that every non-immune person was infected with measles within the short period of 24 hours.

If such is actually the situation, and its truth might be further abundantly illustrated by actual occurrences during the past six years, the fact that the increasing competition between steamship companies may gradually result in adequate remedies being supplied can hardly excuse inaction on the part of those responsible for seeing that what has just been illustrated should no longer be allowed to continue.

As in much of our sanitary progress, if not indeed in all of it, scientific certainty as to our facts is the first essential, so it is especially desirable that the public be informed that progress in this matter will inure to its benefit, and that there will be an elevation of the plane upon which the great commercial and industrial corporations carry on their business.

In the present matter, however, all these several stages have already been reached, both in the United States and in Canada; and from my personal investigations I am convinced that most European countries have likewise realized their duty in relation to the transportation of emigrants. Hence I am convinced that the time and occasion have arrived for making much more scientific and definite the regulations which govern the transportation of emigrants on shipboard, by insisting through boards of trade in the several countries and through immigration authorities that the essential sanitary requirements, which the competition for high class travel has brought about, in the ventilation and other sanitary conveniences of transatlantic vessels, be extended to all ships bringing immigrants to America.

Very stringent regulations are enforced regarding the moral conduct of ship's officers and men in their relation to emigrant passengers; it is surely high time that the sanitation of the vessel in relation to its effect upon their physical well-being be equally cared for.

THE CHEMICAL DISINFECTION OF WATER AND SEWAGE; RECENT DEVELOPMENT AND PRESENT STATUS.

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Recent developments in the use of chemical disinfectants in water and sewage purification have been so rapid and so far-reaching in their consequences that there has resulted a somewhat unusual situation. Processes so novel and of such importance that they have been spoken of as epoch making have been adopted with a rapidity and to an extent that has probably never been equaled in any other single instance; whereas the total amount of available literature and information upon these processes is probably much less than upon any other important process that has ever been developed. This condition is primarily due to the unusual simplicity and cheapness of the processes themselves, and, secondarily, to the fact that they were first called to the attention of those interested at a time when their need was urgently felt. There can be no possible question of their general value and usefulness, and the present indications are that they are rapidly coming into very general use. The possibility of danger in advancing our practice so far ahead of discussion and recorded experience must be obvious. Especially in inexperienced hands may this apparent simplicity of disinfection methods prove to be a delusion; and instances are not wanting, even at the present time, when unforseen and unexpected difficulties have been encountered. Therefore the time seems opportune for a general discussion of the principles underlying the chemical disinfection of both water and sewage, with especial reference to their scope and limitations in the general scheme of purification methods.

We are further advanced to-day in our knowledge of methods of chemical disinfection or sterilization than we are in the knowledge of when these processes may be legitimately used. To this latter aspect of the problem therefore attention is particularly directed at this time.

DISINFECTION OF SEWAGE.

The action of disinfectants upon either water or sewage is primarily a germicidal one; if at the same time slight chemical changes are produced in the other impurities these are incidental and immaterial factors. The disinfection of sewage is therefore called for only under conditions in

* Read at 38th Annual Meeting of American Public Health Association, Milwaukee, September, 1910.

which it is deemed undesirable to allow the discharge of living organisms. Since the pathogenic organisms are the only ones that we may regard as being undesirable, it follows that chemical disinfection of sewage has for its sole purpose the destruction of disease germs. It seems necessary to point out this fact on every possible occasion. The so-called chemical treatment of sewage, or, as it is sometimes described, the chlorine process of sewage purification, seems to have established a name for itself in the lay mind as being a cheap substitute or alternative process for sewage purification of other kinds. It cannot be stated too emphatically that the disinfection of sewage is not a substitute for anything else. None of the other processes of sewage treatment have for their primary object the destruction of germs, unless it be possibly the old slow sand filter. Even if the destruction of germs be the aim in the use of the sand filter that object is rarely attained to any satisfactory degree in practice. No other type of sewage purification can be relied upon to produce bacterial destruction. Effluents from such processes are often no better from a sanitary standpoint, i. e., with reference to the possible presence of disease germs, than the original untreated sewage. It has been the writer's observation that the removal of bacteria observed in various methods of sewage purification is not essentially different from that which is observed in an equal period of time in the stream. Therefore the process of chemical disinfection is unique. It is not a substitute for any other process but a new process with a single and practically unique purpose—the destruction of germs.

Whether or not the destruction of germs is necessary or desirable in any given case is a matter for local consideration. A few of the general principles involved may be laid down without going into any lengthy discussion of the relative merits of sewage purification and water purification in the protection of public water supplies. Surface waters flowing through a populated region require purification to render them safe for domestic purposes, even though they do not receive direct sewage pollution. Furthermore, it is possible to purify badly polluted waters so as to render them fit for domestic use. From these two postulates the position is not infrequently taken, even by some of our eminent state health authorities, that water purification is a sufficient barrier to interpose between the water consumer and a grossly polluted stream, and that efforts toward sewage purification are not only unnecessary but unwise. It would seem, however, that the question might fairly be raised as to how far it is wise to proceed with the unrestricted pollution of streams even though these waters are to be purified before use. It would seem to be almost an axiom of sanitary science that all reasonable precautions against serious

pollution should be taken, and that sources of drinking water supply should be kept as pure as possible, allowing for their reasonable use. Just what constitutes reasonable use of a stream is a matter upon which our courts are still debating. It is of interest at this time to point out that, with progress in sewage disposal methods by which we are able to obtain results of greater and greater excellence at ever-diminishing cost, there will be constantly greater limitations placed upon the reasonable use of a stream. What may be considered an unreasonable demand upon the polluting community today, may, with the improvement in our processes and the decrease in relative costs, be looked upon in the near future as a perfectly reasonable and just requirement. This has been the situation in the sewage disposal problem from the beginning. Only a few years ago, for the authorities to have insisted upon the discharge of disinfected effluents would have been looked upon as an unreasonable and even a ridiculous demand. Today, with the advent of processes of chemical disinfection, such a demand is not only reasonable but is actually being made and enforced in many parts of the country. Thus one role which this process has played in the field of sanitary science has been to make possible through its reasonableness the more perfect purification of polluting waters, thereby diminishing the burden and increasing the margin of safety of water filters and decreasing by just so much the danger of infection.

A second and far-reaching result which has followed the introduction of this process is the protection of the shell-fish industry. Coming, as it did, at a time when this enormously valuable industry was being threatened by the discoveries of bacteriologists and epidemiologists that there was an intimate relation existing between polluted shell-fish and epidemics of typhoid fever, the process of chemical disinfection has been of great value to this industry. The State of New Jersey is today taking active steps toward the full protection of her shell-fish interests by encouraging, as far as practicable, chemical disinfection of all sewage which could by any possibility reach important shell-fish areas. These two applications of chemical disinfection of sewage have been so readily apparent and have had such far-reaching possibilities that the authorities have not been slow in taking them up. Further than this we have not gone at the present time. The danger of pollution along bathing beaches or in waters used for purposes of commerce have heretofore been considered so slight as hardly to justfy any vigorous protest. Here again it may be proper to point out that with increasing knowledge of the methods of transmission of disease and with continued improvements in the process of disinfection, the applications of these processes are becoming more and more

general and their compulsory use more and more reasonable. Looking at the matter from another point of view, chemical disinfection has made possible the discharge of disinfected crude sewage under conditions which would otherwise necessitate efficient filtration. Under suitable conditions of volume of diluting water and strength of current there may be no apparent necessity for the thorough purification of sewage. Such favorable conditions are frequently met with along the ocean front and lakes and upon the great rivers. If, under such conditions, bacterial purification is called for by reason of any of the causes previously enumerated, then disinfection of the crude or partially clarified sewage is suggested, and in many cases such methods have been employed. It provides the one definite remedy for the existing ills and accomplishes the desired results at a minimum of cost. The misuse of this simple remedy, however, will prove a disastrous experiment.

These are the things that the chemical disinfection of sewage have accomplished or may be expected to accomplish. It is readily seen that these are not the things that are accomplished by other methods of treatment. On the other hand, the disinfection of sewage is not intended to accomplish the purpose of sewage purification in general. The latter is undertaken for the protection of streams and other bodies of water against possible nuisances of the grosser sort or against physical nuisances which follow the discharge of untreated sewage into a stream which is too small to give the proper dilution. Where nuisances of these kinds occur the benefits of chemical disinfection applied to relieve putrefactive conditions or for the destruction of germs which are primarily responsible for this condition, are temporary at best, and in the long run futile. Any attempt to oxidize organic matter and in this way rob the sewage of its putrescible characteristics will also at the present time prove futile by reason of the cost involved. There is a possibility that some cheap chemical method of oxidizing organic matter may eventually be discovered. If ozone could be produced today with any approximation to theoretical efficiency it could undoubtedly be employed for that purpose; its vigorous oxidizing action makes it an ideal reagent. But under the present methods of manufacture, giving as they do only five or six per cent. of the theoretical yield, the cost of ozone makes its use in sewage disposal, even as a germicide, prohibitive.

DISINFECTION OF WATER.

In the field of water purification disinfection by chemical means bids fair to revolutionize our practice; but here again, as in the case we have just considered, careful attention must be paid to the limitations of this

process and the field which it is designed to cover; chemical disinfection of water is only incidentally and partially a substitute for other processes. It happens that in water purification the removal of germs is in general the primary object. In addition to this object, however, and sometimes exceeding it in actual importance, is the removal of other impurities of either mineral or organic origin, color, suspended matter such as loam or clay, or, in certain waters, finely divided material discharged from sewers, are typical examples of the kinds of impurity which it may be desirable to remove. In the absence of impurities of these various types, and in cases where minor sources of continuing bacterial pollutions are present, or in the further case of a temporary but more serious bacterial pollution, the application of chemical disinfection is fully justified. Where the character of the untreated waters is such that, regardless of bacteria, its use is repugnant to the physical senses, then more far-reaching purification than that obtained by mere disinfection, is assuredly indicated. As an adjunct in water purification, disinfection has a much more promising field. Particularly in connection with the mechanical filtration of waters will this process be found valuable. Rates of flow upon slow sand filters are determined primarily by the physical character of the water and the effect of the contained impurities upon the expensive process of washing. On the other hand, rates of treatment on mechanical filters are limited largely by the necessity for bacterial efficiency. Therefore, while in the case of certain special types of water the aid of chemical disinfection may make higher rates of treatment upon slow sand filters possible, this supplementary process will undoubtedly find its widest development in the field of mechanical filtration.

Another possible field for chemical disinfection, which has not received the attention which it deserves, is its emergency use in case of some serious mishap by which the water system suddenly becomes contaminated. It should be the duty of every water-works manager to provide, at relatively slight expense, the necessary storage tanks and chemicals which would enable him at a moments' notice to disinfect his entire supply. If it were never used such a plant would represent a very cheap form of insurance against possible accident and loss of life.

Laboratory Section

THE BACTERIOLOGICAL EXAMINATIONS OF SHUCKED AND SHELL OYSTERS.*

By GEORGE W. STILES, M. D., Ph. D.,
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During the last quarter of a century rapid developments have taken place along all lines of sanitary science, and nowhere is this progress more noticeable and striking than in the realm of food bacteriology. Since the passage of the Pure Food and Drugs Act in 1906, the need of bacteriology as applied to sanitation has been amply demonstrated. This is particularly true in connection with the production, care, and handling of all kinds of food material, both in their raw and in their finished state.

The question as to the possibility of oysters and other shell-fish becoming contaminated with sewage-polluted water was one of the first problems to receive consideration after the passage of the Food Law. At the solicitation of a committee representing the North American Oyster Growers and Dealers Association, Dr. H. W. Wiley, Chief of the Bureau of Chemistry, arranged to have the necessary investigation made to study the whole oyster situation. Various phases of the industry were taken up and systematically considered in detail. The writer was instructed to take up the industry from the standpoint of the bacteriologist.†

From the sanitary point of view the ruling of the Food and Drug Inspection Board made it unlawful to ship or sell in interstate commerce oysters or other shell-fish taken from polluted beds. This order also made it unlawful to sell or ship in interstate commerce oysters or other shell-fish which have become polluted because of being packed under insanitary conditions or being placed in unclean receptacles. It was further considered unlawful to ship or sell in interstate commerce shucked oysters to which water has been added, either directly or in the form of melted ice. Food Inspection Decision No. 121, an amendment to F. I. D.

* Read before the Laboratory Section of the American Public Health Association, Milwaukee, September, 1910.

† The difficulty which in the beginning caused the greatest annoyance to the Oyster Growers' and Dealers' Association was the mooted question as to the best manner of shipping oysters. After the completion of exhaustive experiments carried on under different commercial conditions, and representing various sections of the oyster-producing territory, the conclusions and results of these investigations, together with public hearings with practical oystermen, were condensed and issued October 15, 1909, in the form of F. I. D. No. 110.

110, issued June 4, 1910, concludes by saying, "Oysters found in interstate commerce in a polluted condition because of the character of the water in which they are grown or floated are adulterated under the Food and Drugs Act."

Having finished our shipping experiments, and concluding that shucked oysters should be no longer shipped or sold with ice in contact, our attention was directed to the more serious aspect, viz:, the possibilities of shellfish pollution from sewage polluted water.*

The combined oyster investigations have covered the oyster season of 1908, 1909, and 1910, and the writer has personally gone over the oyster layings, collected samples of water and shell-fish for examination, and at the same time made a careful sanitary inspection of each locality visited. Our investigations have extended from Maine along the Atlantic Coast to the Gulf of Mexico. Approximately one thousand samples of oysters, quahaugs, soft clams, and sea water have been collected and examined bacteriologically during these three years of investigations. These samples represent the product during every step from source of production to consumer.

COLLECTION OF SAMPLES.

SHELL STOCK—Samples of quahaugs (hard clams), soft clams, and oysters in the shell, were fished from the beds by tongs, forks, or dredges, and each sample was properly labeled and shipped to Washington in metal cans generally surrounded by ice, no water coming in direct contact with the samples. During the coldest weather no ice was used for shipping samples.

OPENED STOCK—Shucked oysters and clams were examined, either at the cities in which they were obtained ,or else were shipped, well refrigerated, to the laboratory from short distances,. They were taken from original containers, and placed in sterilized Mason jars. Examinations were begun immediately after their receipt

PREPARATION OF SAMPLES.

SHELLSTOCK—Oyster and clam shells were thoroughly scrubbed in running hydrant water, rinsed in sterile water and the laid between sterile towels to dry. Five medium-sized cleansed oysters were selected, and the lips of each shell were slightly flamed before opening. They were opened with a sterile oyster knife under aseptic conditions. Either the liquor should be drawn off by using sterile pipettes, or the excess of liquor may be decanted into sterilized wide-mouth flasks. We formerly used both the liquor and minced meat of the shellfish for examination, but have

* The writer has now under preparation the report on this phase of the industry, the substance of which has already been presented as a thesis to the George Washington University for the Degree of Ph. D.

now concluded that the liquor represents sufficiently well the whole contents of the shell. The liquor from each oyster for cultural purposes should be placed in separate containers.

OPENED OYSTERS—The liquor from shell stock and that from market shucked oysters is treated in the same manner as any fluid material. In the beginning of our investigations complete samples of five or more shell-fish were treated as one sample. In addition to the use of composite samples we now endeavor to supplement, or rather to precede this method, by inoculating bile or dextrose fermentation tubes with 1 cc., 0.1 cc. and 0.01 cc. of liquor from each oyster and then combining the residue of the five shell-fish to constitute the composite sample. This scheme gives the *B. coli* content for each oyster, as well as the combined lot of five oysters, and enables one to judge more accurately of the character of the material than could be done by a single analysis.

MEDIA EMPLOYED.

PLAIN AGAR AND NUTRIENT BEEF BROTH—This is prepared according to standard methods recommended by the American Public Health Association.

BILE SALT AGAR—Prepared after the formula suggested by MacConkey. Contains 1.5 per cent. powdered agar to the liter of water, 0.5 per cent. sodium taurocholate, 2 per cent. peptone, 1 per cent. lactose, and a sufficient quantity of a 1 per cent. of neutral red to give a light red color to the finished medium. Plates prepared with this medium are incubated 24 to 48 hours, at 37° C. for the isolation of colon-like organisms When present, these organisms appear as smooth, round, raised, entire, glistening, pink colonies. Experience with the use of this media is necessary to enable one to select *B. coli* types from other gas-producing bacteria.

The media used for differential purposes are as follows: (1) Plain agar slants, (2) peptonized beef broth, (3) alkaline litmus milk, (4) potato, (5) Dunham's peptone solution, (6) 2 per cent. dextrose broth, (7) 2 per cent. lactose bouillon, (8) 2 per cent. saccharose bouillon, (9) nitrate-broth, (10) gelatin—all prepared according to standard methods. Cultures are made from well-isolated colonies on bile salt agar and the results noted after inoculation in the above media for a period of not less than two weeks, a longer time should be allowed if practicable.

PLATING SAMPLES.

LIQUOR DIRECT FROM SHELL STOCK—(a) Plate 1 cc., 0.1 cc., 0.01 cc. and 0.001 cc. quantities on plain agar at 20° C. to 25° C. (b) Same quantities plated on plain agar and bile salt agar and incubated at 37° C. Plates incubated from 2 to 4 days according to temperature.

OPENED OYSTERS—Opened market oysters generally require higher dilution than the shell stock, because they usually contain more bacteria. Our experience has shown that dilutions of 0.01 cc., 0.001 cc., 0.0001 cc., 0.00001 cc. or 0.000001 cc. may be necessary, according to age and condition of the oysters, in order to count the colonies. Instead of using only one or two dilutions we employ at least four, attempting to cover the ground above and below the probable bacterial content.

In order to determine the presence of gas-producing organisms and streptococci, we are largely relying upon the use of sterilized ox-bile containing 2 per cent. lactose and 1 per cent. peptone. The bile medium is placed in ordinary test tubes containing small, inverted glass tubes sealed at one end. This form of tube is used in preference to the regular Smith fermentation tubes which are cumbersome, easily broken, and expensive.

STREPTOCOCCI—After about 48 hours' incubation at 37° C., smear preparations are made and stained from the various dilutions of liquid bile cultures. These smears are examined for the presence of streptococci. The diagnosis is made from their morphology alone, no attempt being made regularly to isolate and study them in pure culture. Only cultures showing well-formed chains of organisms are considered positive.

B. coli TYPES—*B. coli* types and allied organisms are isolated in pure culture, either from the initial bile salt agar plates, or, in case of failure from this source, the highest dilution showing the presence of gas-producing organisms is plated on bile salt agar and *B. coli* recovered. Besides observing the staining and morphological characters, all colon-like types of organisms are planted in each of the ten media above described. These cultures are observed from one to three weeks; the gelatin cultures, however, are usually kept for a longer period.

According to our experience, no two strains of colon-like organisms, even from the same source, will give exactly the same biological reactions. Because of this slight variation in some of the lesser details of growth and behavior on culture media, we report all colon organisms as *B. coli-types*, instead of the classical *B. coli communis*.

In my opinion, the presence of *B. coli* in appreciable numbers in any food material, is positive evidence of fecal contamination and sufficient to condemn the product for human consumption.

The appended tables illustrate the relative bacterial content of oyster and clam liquor, taken directly from the shells under aseptic conditions, when compared with the liquor of opened market oysters shucked under ordinary circumstances.

TABLE No. 1.

RESULTS OF THE BACTERIOLOGICAL EXAMINATION OF OYSTER LIQUOR IN THE SHELL, COLLECTED FROM MISCELLANEOUS SOURCES. OPENED UNDER ASEPTIC CONDITIONS. SEASON OF 1909 AND 1910.

No.	Organisms per cc. after 3 days' incubation			*B. coli* type. 2% Dextrose fermentation tubes	Number of individual oysters showing presumptive *B. coli* in 1 cc., 0.1 cc. and 0.01 cc., quantities of liquor.
	Plain Agar 25° C.	Plain Agar 37° C.	Bile Salt Agar 37° C.		
1	500	50	0	1	2 out of 5 in 1 cc.
2	9,900	240	260	1	1 out of 5 in 1 cc.
3	600	230	110	1	1 out of 5 in 1 cc.
4	3,000	1,000	400	0	0 out of 5 in 1 cc.
5	10,000	1,900	440	10	1 out of 5 in 1 cc., 1 in .01 cc.
6	5,100	700	1,100	10	2 out of 5 in 1 cc., 2 in 0.1 cc.
7	3,800	410	30	1	1 out of 5 in 1 cc.
8	10,500	4,400	500	1	2 out of 5 in 1 cc.
9	4,000	2,700	1,200	10	3 out of 5 in 1 cc., 1 in 0.1 cc.
10	3,800	1,800	60	10	2 out of 5 in 1 cc., 1 in 0.1 cc.
11	23,000	1,000	400	100	4 out of 5 in 0.01 cc.
12	1,900	50	0	0	
13	1,100	230	20	0	
14	8,400	320	0	0	
15	8,000	700	0	0	
16	2,400	600	100	0	
17	5,000	400	100	0	
18	4,000	400	0	0	
19	1,000	80	0	0	
20	20,000	1,000	200	0	
21	600	400	0	0	
22	3,200	900	100	0	
23	26,000	2,000	1,200	10	
24	16,000	2,100	70	10	
25	9,000	2,000	40	1	
26	210	60	0	0	
27	4,000	2,000	100	0	
28	500	100	30	0	
29	7,000	600	40	10	
30	1,400	500	300	100	
31	6,000	3,000	100	0	
32	150	20	0	0	
33	8,000	900	100	0	
34	700	100	10	0	
35	2,000	1,100	100	0	
36	11,000	1,200	50	0	
	6,000	1,000	200	7+	

Maximum count 26,000, minimum 150 organisms per cc. of liquor.

Maximum *B. coli*-type 100, minimum 0, per cc.

Results show that 21 of the 36 samples contained no *B. coli* in 1 cc. quantities, while only 9 of the remaining 15 samples showed more than one *B. coli* per cc. of the liquor.

TABLE No. 2.

RESULTS OF THE BACTERIOLOGICAL EXAMINATION OF QUAHAUGS (HARD CLAMS), COLLECTED FROM MISCELLANEOUS SOURCES, OPENED UNDER ASEPTIC CONDITIONS SEASON OF 1909 AND 1910.

No.	Organisms per cc. after 3 days' incubation			*B. coli* type. 2% Dextrose fermentation tubes 37° C.	Number of individual clams showing presumptive *B. coli* in 1 cc. and 0.1 cc. quantities of liquor.
	Plain Agar 25° C.	Plain Agar 37° C.	Bile Salt Agar 37° C.		
1	70,000	40,000	8,000	10	5 out of 5 in 1 cc., 1 in 0.1 cc.
2	12,000	10,000	700	10	2 out of 5 in 1 cc., 1 in 0.1 cc.
3	15,000	5,000	1,200	1	5 out of 5 in 1 cc., 0 in 0.1 cc.
4	16,000	10,000	800	1	2 out of 5 in 1 cc., 0 in 0.1 cc.
5	30,000	19,000	8,000	10	5 out of 5 in 1 cc., 4 in 0.1 cc.
6	10,000	1,000	900	0	
7	90,000	11,000		1,000	
8	90,000	11,000		100	
9	263,000	43,000		100	
10	4,300,000	50,000		10	
11	16,800	12,800		100	
12	105,000	51,000		100	
13	97,000	45,000		100	
14	2,000	500		10	
15	23,500	8,000		100	
16	91,000	47,000		100	
17	31,000	13,000		1,000	
18	8,600	5,000		0	
19	6,800	3,500		0	
20	198,000	19,000		1,000	
	275,000	18,000	3,000	180	

NOTE—Maximum count at 25° C. 4,300,000, minimum 2,000 organisms per cc. Maximum *B. coli*-type 1,000, minimum 0, per cc. liquor.

Results show that these clams contained more bacteria than did the shell oysters. This may be partly explained by the fact that many of the samples were collected from highly polluted water.

Sample No. 10 also raises the average higher than would be the case under ordinary conditions.

TABLE No. 3.

RESULTS OF THE BACTERIOLOGICAL EXAMINATIONS OF 33 SAMPLES OF SHUCKED MARKET OYSTERS COLLECTED JANUARY, 1910.

No.	Organisms developing after 3 days			2% Dextrose Fermentation tubes	
	Plain Agar		Bile Salt Agar	*B. coli* per cc.	Streptococci per cc.
	25° C.	37° C.	37° C.		
1	425,000	40,000	7,000	10,000	100
2	245,000	33,000	1,500	1,000	1,000
3	2,350,000	1,550,000	185,000	100,000	10,000
4	575,000	95,000	6,500	100,000	0
5	285,000	8,000	8,000	10,000	0
6	4,750,000	200,000	4,000	100,000	0
7	137,000	23,000	4,000	10,000	0
8	450,000	110,000	7,000	10,000	100
9	750,000	450,000	450,000	100,000	1,000
10	135,000	40,000	23,000	10,000	1,000
11	245,000	70,000	9,000	10,000	10,000
12	1,050,000	500,000	75,000	100,000	1,000
13	260,000	150,000	85,000	100,000	10
14	2,250,000	225,000	32,000	100,000	10
15	175,000	31,000	7,000	1,000	10,000
16	2,300,000	1,500,000	250,000	1,000,000	100,000
17	430,000	45,000	5,000	10,000	1,000
18	1,450,000	350,000	65,000	100,000	1,000
19	700,000	250,000	80,000	100,000	10
20	250,000	215,000	20,000	10,000	1,000
21	105,000	45,000	300	100	10
22	3,200,000	1,750,000	30,000	100,000	1,000
23	550,000	155,000	21,000	10,000	10
24	900,000	195,000	12,000	10,000	1,000
25	1,450,000	125,000	2,500	100,000	1,000
26	750,000	55,000	4,000	10,000	10,000
27	400,000	11,000	1,500	1,000	1,000
28	365,000	18,000	2,500	10,000	10
29	290,000	112,000	25,000	100,000	1,000
30	15,500	2,200	Below 100	0	1,000
31	280,000	140,000	50,000	100,000	100,000
32	550,000	17,000	1,000	10,000	10
33	550,000	11,000	1,000	1,000	0
	867,000	268,000	45,000	74,000	8,000

NOTE—Maximum count at 25° C. 4,750,000, minumim 15,500 organisms per cc.
Maximum number *B. coli*-type 1,000,000, minimum 0, per cc. liquor.

Results obtained from plating duplicate samples. Shell stock opened under ordinary commercial conditions usually kept with ice in contact in uncovered containers.

Sample represents both freshly opened oysters and those of a variable length of time out of the shell.

The contamination of oysters may occur from any one or more of the following sources:

(a) Contaminated grounds.

(b) Polluted water in which they are floated.

(c) Insanitary shucking houses.

(d) Washing with impure water and contaminated ice.

(e) Unclean methods of handling, packing, and shipping.

(a) Vast areas of valuable oyster grounds are admirably located for oyster culture all along the Atlantic Coast. Years ago no difficulty was experienced from pollution by sewage, but the conditions have now changed. Many localities where oysters grow are dangerously polluted, and the extent and seriousness of this pollution will continue to increase so long as man is content to discharge his waste promiscuously into our natural bodies of water. Sewage is the greatest enemy to the progress of the oyster industry. The practical solution of this problem resolves itself into one of two things, either the shell-fish must be removed from the polluted water, or else the untreated sewage must not be allowed to flow into the water over shell-fish layings.

(b) Oysters grown on grounds free from contamination will become infected if floated in sewage-polluted water. Many of the recorded epidemics of disease resulting from eating contaminated oysters were those which the oyster had been previously floated in sewage-polluted water. As ordinarily practiced, the process of floating oysters in water of a questionable purity should be prohibited.

(c) The ordinary oyster-shucking establishment is an extremely insanitary place. There are, however, a few modernly constructed buildings, fully equipped with sterilizing facilities and proper methods for carrying on such business where sanitary measures are enforced. Oyster houses should be built and so arranged as to be kept free from cobwebs, dust, filth, and the undesirable elements.

(d) Shucked oysters should be washed with pure water and ice. Contamination may result from this source alone. Natural ice froxen from polluted water will contaminate oysters if it is placed in the water for washing purposes.

(e) Unclean methods of handling, packing, and shipping oysters may result in contamination of the product, even though it is free from pollution at the beds. All utensils, tubs and containers used by oystermen should be efficiently cleaned and sterilized by the use of live steam or BOILING water. Oysters produced and handled under clean conditions, and properly refrigerated, will remain in good condition for several days.

CONCLUSIONS.

Shucked oysters, as ordinarily found on the market, contain more bacteria per given volume of liquor than oysters opened directly from the shell under clean conditions.

The bacterial content of opened market oysters may include numerous colon bacilli and streptococci. Each of these organisms is not only evidence of fecal contamination, but to my mind, when present in such large numbers as indicated in table No. 3, their toxins may cause gastro-intestinal derangements of a serious nature, if consumed raw by susceptible individuals.

Oysters may be grown on pure grounds and remain in good condition while in the shell, but, because of unclean methods of shucking and handling they may be subsequently contaminated and rendered unfit for food.

There is no assurance that shucked market oysters are always cooked before consumption. They may be served raw on old shells, in the form of cocktails, on plates, or in some other manner.

Oysters intended for human consumption should be grown in water free from pollution, and the greatest care should be exercised to keep such a product in a clean and wholesome condition until consumed.

THE SOURCE, MANUFACTURE AND COMPOSITION OF COMMERCIAL AGAR AGAR.*

By H. A. WHITTAKER, B. A.,
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Agar agar or Japanese isinglass, the seaweed well known in commerce, is derived from several species of aquatic plants. It is made principally from algae of the genus *Gelidium* (a). The species (b) most commonly in use are *Gelidium Amansii, Lam., G. elegans, Kutz., G. polycladum, Kutz.*, and more sparingly, *G. Japonicum, Okam., G. Subcostatum, Schmitz,and Acanthopeltis Japonica, Okam.* The species (b) which are added to the inferior qualities of the article are probably *Camphylaephora hypneoides, Ceramium rubrum, Gracilaria confervoides and G. lichenoides.*

A large proportion of the world's output of this product is collected and manufactured in Japan. The term "*kanten*" is applied by the Japanese to the product comparable with agar. The algae grow on rocks along the coast and are collected by divers during the period between May and October, the best months being July and August. The weed is dried on the shore during which process it is partially bleached and is then ready to be manufactured into the commercial product.

A brief account of the method of manufacture as described† in the Bulletin of the Bureau of Fisheries, will be of interest here.

"The process of making *kanten* is quite elaborate, although the appliances required are simple and inexpensive.

(1) The first step is the removal of all foreign matter from the masses of dried algae. Calcareous and other hard particles are dislodged by beating and pounding, and other substances are picked out by hand. Further cleaning is effected by washing in running fresh water.

"(2) The wet algae are then spread in thin layers on flakes with bamboo or reed tops, through which the water drains. The principal object in thus spreading the algae is to bleach them; this is done in warm weather, beginning in August, and is facilitated by dew. Under favorable conditions, twenty-four hours may be sufficient, but usually several days are required.

"(3) As the drying goes on, the algae become agglutinated and more or less fused, forming loose-meshed sheets. These sheets are loosely rolled, and, as required, are boiled in fresh water in a large iron kettle or a wooden tub placed over a specially constructed oven or furnace. The boiling extracts the gelatin, and a thick, pulpy mass results. From the boiling kettle the jelly is strained or filtered

* Read before the Laboratory Section of the American Public Health Association Milwaukee, September, 1910.

† Vol. XXIV, 1904, pages 137-141.

through coarse cloths into a vat or tank, this preliminary straining being followed by a more thorough straining through linen bags of coarse mesh which are placed in a crib and squeezed by means of a lever, the jelly falling into a large vat under the press.

"(4) From the vat the jelly is dipped with a peculiar rectangular wooden vessel and poured into wooden trays to cool. These trays are about 2 feet long, 1 foot wide, and 3 inches deep, and are arranged in rows in the open air, resting on parallel poles so as to be clear of the ground.

"(5) At a certain stage of the cooling and hardening process, the contents of the trays are cut into pieces of uniform size, in order to facilitate handling. The cutting is done by means of oblong iron frames, adapted to the shape of the trays, divided into squares of various sizes. One face of the frame has sharpened edges, and the cutting is done by inserting the frame along one side of the tray and drawing it horizontally through the jelly.

"(6) The bars are then put one by one in a wooden box slightly larger than themselves and with a coarse wire grating over the lower end. A wooden piston with a broad end fits into this box, and is pushed against the bar of jelly, forcing it through the grating in the form of slender sticks. Another way in which *kanten* is prepared is in the form of blocks, $1\frac{1}{4}'$ to $1\frac{1}{2}'$ inches square and 10 to 12 inches long, which are made with a cutting frame such as has been referred to. There is a shrinkage of one-third in bulk in the course of solidifying.

"(7) The sticks and bars of hardening jelly are arranged in regular rows on flakes occupying an exposed position on a mountain or hillside. The congealing requires one to three days, according to wind and temperature, and a further drying of three or four days is usually allowed. A northwest wind is considered as giving the best results.

"(8) The thoroughly dried pieces are trimmed to uniform lengths and baled for shipment. The thin sticks, known as *huoso-kanten* (slender *kanten*), are 10 to 14 inches long and about one-eighth of an inch thick, and are tied into bundles weighing about 6 to 10 ounces; the bundles are packed in bales holding 100 kin (33 pounds), incased in several layers of matting. The blocks, which are called *kaku-kanten* (square *kanten*), are not adapted for close packing, and make a very bulky bale; about 50 blocks weigh 1 pound."

THE CHEMICAL COMPOSITION OF AGAR AGAR.

Since agar was first applied by Hesse in the preparation of culture media its use has become more extensive each year in bacteriological work. Investigations on the composition of this material have appeared from time to time in chemical literature. Reichardt (e) was probably the first to study agar as a carbohydrate. Bauer (d) later hydrolized agar with dilute sulphuric acid and isolated a sugar corresponding to lactose. By lactose Bauer understood the sugar which is today called galactose.

Payne (e) found in agar a carbohydrate and named it gelose. To this he ascribes the gelatinizing power of this substance in aqueous solution. Gelose (f) is said to contain C 42.77; H 5.77; O 51.45 percent. This

composition corresponds to the formula $C_{11}H_{16}O_{10}$ but the formula $C_6H_{10}O_5$ is sometimes used. According to Bauer (g) and Porumbaru (h) gelose has the same elementary formula as gelactan.

In the more recent investigation of Konig and Bettels (i) the products of agar have been carefully studied. Their work includes a resumé of previous investigations and contributes much valuable material on the products resulting from the hydrolysis. They have separated from the liquid resulting from hydrolysis with acid, compounds comparable with laevulinic acid and galactose. The discovery of galactose corroborates the results of Bauer before mentioned. They further examined the flocculent precipitate formed on hydrolysis with acid and found it to consist of cellulose.

This laboratory has found it impossible to secure a consistent product from different shipments of agar even when the same form and quality was specified. It was further noted that this variation materially affected the appearance of the media in which it was used.

TABLE I. THE CHEMICAL COMPOSITION OF COMMERCIAL AGAR AGAR.

No.	Form	Quality	Price per Lb.	Moisture	Crude Fiber	Crude Protein (Nx6.25)	Carbohydrate	Ash
1	Slender	No. 1	$1.60	13.10	0.47	2.21	80.34	3.88
2	"	No. 2	1.00	13.37	4.27	2.06	76.27	4.03
3	"	No. 3	.80	13.79	1.12	2.41	79.26	3.42
4	"	Best	.75	14.39	0.35	1.49	80.17	3.60
5	"	"	.65	15.20	0.41	2.02	78.52	3.85
6	"	"	1.00	16.39	0.77	1.71	77.62	3.51
7	"	"	1.14	15.64	0.40	3.25	77.47	3.23
8	"	"	.90	15.46	0.39	1.77	78.89	3.49
9	Powdered	"	1.60	11.39	2.62	3.58	74.91	7.50
10	"	"	1.30	13.92	0.42	2.46	79.65	3.55
11	"	"	1.60	13.71	0.16	2.18	80.06	3.89
12	"	"	1.48	13.48	0.23	1.85	80.53	3.91
13	"	"	1.40	14.54	0.36	3.11	78.30	3.69
14	"	"	1.50	14.86	0.27	1.85	79.46	3.56
15	Bar	"	.80	15.13	0.72	3.16	77.11	3.88
16	"	"	1.32	16.03	0.37	1.16	78.75	3.69
17	"	"	.85	16.50	0.30	1.17	78.49	3.54
Minimum			.65	11.39	0.16	1.16	77.11	3.23
Maximum			1.60	16.50	4.27	3.58	80.53	7.50
Average			1.16	14.52	0.80	2.20	78.57	3.89

Determinations of moisture and Ash by B. M. Mohler.

The analyses recorded in Table I were made for the purpose of determining what variations existed in the different forms and qualities of agar now sold to laboratories for the manufacture of culture media. These samples were purchased from the following distributors in this country: E. Leitz & Co., Eimer & Amend, New York; A. H. Thomas, Philadelphia; Bausch & Lomb, Rochester; Henry Heil & Co., St. Louis; E. H. Sargent & Co., Chicago; Noyes Bros. & Cutler, St. Paul and O. Kai & Co., San Francisco. The three forms common to the trade were secured, namely, slender, bar, and powdered. The two forms most easily secured are slender and powdered. The bar form appears not to be so well known to the dealers. Several of the large distributors claim to purchase their supply from importers who secure their material directly from the Japanese maunfacturers. It was found possible to purchase from certain dealers three qualities of the product, Nos. 1, 2 and 3.

The analytical methods used in the determinations made in Table I are those recommended by the U. S. Department of Agriculture.* The carbohydrate in all cases was determined by difference.

Table I includes data and analyses on seventeen samples of material collected. This includes eight samples of the slender, six of the powdered, and three of the bar form. The price paid for the same quality and form ordered varied from $0.65 to $1.60 per pound. The analytical results show appreciable variations in the composition of the samples exmained. These differences are probably due to the species of algae used and the care taken in the collection and preparation of the material for market.

The portion of agar essential in the preparation of culture media as it is commonly used is the carbohydrate content furnishing the gelatinizing power; hence the exclusion of other material may be assumed to add to the purity of this product for this specific purpose. Therefore the gross standard of purity used in the discussion of these results is based upon the above assumption.

The moisture content of agar, as in other materials possessing absorptive powers, fluctuates with the atmospheric conditions under which it is kept. The differences noted in the results may be due either to the absorptive power of the different samples or the varying atmospheric conditions to which they were subjected.

The crude fiber includes principally the coarse cellulose content not separated from the other material in manufacture. The differences in the results are due to the imperfect filtration or straining of the liquid agar

* Bulletin 107, U. S. Dept. Agric., Bu. of Chem., General Methods for the Analysis of Foods and Feeding Stuffs.

before drying for market. The high results indicate careless preparation of the product.

The crude protein as designated in the table is the product of the total nitrogen and the empirical factor 6.25. The variation in results is probably due to the different species of algae used, the amount of nitrogen available for different plants of the same species, and the amount of soluble nitrogen extracted in preparation.

The carbohydrate content was determined by difference and is intended to include the gelatinizing principal of the material. This result naturally fluctuates with the total percentage of the other determinations. The exclusion of other materials brings up the carbohydrate content.

The ash includes the mineral matter. The differences noted in analytical results are due to the normal inorganic constituents of the algae, the diatomaceous substances found with the plant in sea water, and the character of the water used in the process of manufacture. The water soluble portion of this content should be entirely removed.

Attention is called to analyses Nos. 1, 2 and 3. It appears that the quality branded by the distributor bears no relation to the chemical composition. Sample No. 2 of second quality is analytically inferior to No. 3 of third quality. The form appears to be no index to purity as quite comparable analyses are found in all forms. The unusually high ash content in sample No. 9 was found to be largely silicon dioxide and may have been added as an adulterant.

THE INORGANIC COMPOSITION OF THE ASH.

It is important in some lines of bacteriological work to know the inorganic constituents of agar, for instance, in the preparation of synthetic media. Inorganic salts are generally known to affect the activity of certain organisms in specific media; it is therefore necessary in cases where agar is used to have a knowledge of the composition of the ash representing the inorganic content.

The results given below in Table II were made on the ash as determined in Table I on samples Nos. 2, 4, 5 and 17. The results are expressed in grams per 100 grams of agar.

TABLE II. THE INORGANIC COMPOSITION OF THE ASH OF AGAR.

Sample No.	No. 5	No. 2	No. 17	No. 4
Silicon dioxide, SiO_2	0.24	0.62	0.34	0.39
Iron and Aluminum, Fe and Al	.17	.16	.15	.16
Calcium, Ca	.57	.88	.35	.66
Magnesium, Mg	.44	.10	.41	.26
Sodium and Potassium, Na and K	.29	.12	.16	.11
Sulphate, SO_4	1.76	1.49	1.94	1.56
Chlorine, Cl	.30	tr	.20	tr
Bromine, Br	0.	0.	0.	0.
Iodine, I	0.	0.	0.	0.
Phosphate, PO_4	0.	0.	0.	0.
Carbonate, CO_3	0.	0.	0.	0.
Total Ash	3.85	4.03	3.54	3.60

Attention should be called to the fact that prolonged heating was required to completely convert the organic material in these samples to ash, and this may have affected certain of the results, such as the bromine, iodine and carbonate.

THE ABSORPTION OF MOISTURE.

Agar like many other organic substances readily takes up moisture when exposed to a moist atmosphere. The analytical results (Table I) show a minimum absorption of 11.39 and a maximum of 16.50 per cent. under ordinary conditions. Several samples of agar were dried to constant weight and placed in an atmosphere practically saturated with water at a temperature of 28° C. Table III shows the percentage of moisture normally present and the total percentage absorbed after exposure to a saturated atmosphere at 28° C.

TABLE III. MOISTURE ABSORPTION OF AGAR.

Sample No.	% Moisture Under Normal Conditions	% Moisture In Saturated Atmosphere 28° C.
1	13.10	28.10
2	13.37	27.60
3	13.79	27.70
6	15.20	28.70
17	16.50	28.20

These results show that under conditions not unreasonable to expect in certain sections of the laboratory, agar will absorb a large amount of moisture. In this way large errors may be made in the preparation of

agar solutions of definite strength unless the material is dried to constant weight before use. For example, a sample containing 15% moisture if used to prepare a 1.5% agar solution would result in a solution containing only 1.28% agar, while a sample containing 28% moisture would result in a 1.08% solution. It should be required in the preparation of culture media that agar be dried to constant weight at 100° C. before use.

PURIFICATION OF AGAR BY AQUEOUS EXTRACTION.

In order to determine the amount of material removed from agar by aqueous extraction, 10 grams of commercial agar (sample No. 2) was placed in 1000 cc. of distilled water and allowed to stand for 18 hours, the extract was then filtered, replaced by a second 1000 cc. of distilled water, and again extracted for 24 hours as before at room temperature. The agar was then dissolved in 1000 cc. of distilled water and filtered through fine cotton gauze. The resulting liquid was evaporated to dryness on the water bath, allowed to stand exposed in the laboratory for three days to absorb normal amount of moisture and analyzed. The following are analyses of sample No. 2 before and after purifying.

	Moisture	Crude Fiber	Crude Protein	Carbohydrate	Ash
Before	13.37	4.27	2.06	76.27	4.03
After	12.25	0.	1.67	83.72	1.67

The aqueous extract evaporated to dryness and heated to constant weight at 100° C., showed a total removal of 20.3% of material of which 2.36% was ash. The treatment of sample No. 5 in a similar manner removed 18.03% of soluble material.

These results indicate that by simple aqueous extraction and filtration a large amount of objectionable material can be removed.

SUMMARY AND CONCLUSIONS.

1. Commercial agar agar as found upon the American market is a variable product which can be much improved by careful selection and preparation of the material by the manufacturers.

2. It is suggested that a standard of quality be specified in the purchase of material used for bacteriological purposes requiring less than 15% moisture, 0.5% crude fiber and 2.5% ash.

The analysis of the ash shows the presence of inorganic constituents common to plant life from such a source, and this knowledge may be important in the preparation of certain culture media.

4. The results show the amount of moisture absorbed by agar to vary approximately from 13% to 28%, and it is suggested that all agar used in preparing media of definite percentage strengths be dried to constant weight at 100° C. before use.

5. The aqueous extraction and filtration of agar, as described, removes a large percentage of objectionable material for bacteriological purposes.

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SOME RESULTS OBTAINED FROM THE DIGESTION OF SUSPECTED TUBERCULAR SPUTUM.*

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In 1906 one of the writers (B. R. R.) read a paper§ before the Laboratory Section of the American Public Health Association, describing a shaking machine devised for the purpose of thoroughly agitating sputum specimens, thus breaking up all caseous particles and coagulated masses, and rendering the material to be examined entirely homogeneous. Comparative results on 1000 specimens showed that not only was the chance of finding tubercle bacilli increased when they were very few in number, but the increased ease of manipulation rendered the use of the machine of value in any event. Experiments on the digestion of sputum with caustic alkali were at that time under way and were quoted in the paper mentioned, but subsequent experiments showed that the use of this and certain other digestants were attended with some uncertainty, as there appeared to be some tendency to dissolve the tubercle.

Numerous articles have appeared in medical papers advocating the use of an alkaline solution sold under the trade name of antiformin as a digestant for sputum. The authors therefore decided to compare the results obtained with undigested shaken specimens of sputum with the results obtained on the same specimens after digestion. As the work progressed several methods of applying the digestant were tried. As there was some delay in obtaining the necessary apparatus the number of tests made were consequently limited to the number of specimens of sputum submitted between April 1, 1910 and August 15, 1910.

The new model shaking machine used gives the specimens a slight sideways as well as an up and down motion, and results in a much more thorough agitation in a shorter space of time than could be possible with the simple to and fro motion of the old model.

* Read before the Laboratory Section of the American Public Health Association, Milwaukee, September, 1910.

† Formerly Chief of Laboratories, Ohio State Board of Health.

‡ Formerly Bacteriologist, Ohio State Board of Health.

§ Vol. XXXII, Pt. 2, page 119.

Three lines of procedure were followed:

PROCEDURE 1. At first the sputum was shaken for seven minutes, and a portion smeared, stained, and examined, the remaining portion being afterwards treated with antiformin (2 to 3 cc), shaken for five minutes, treated with ligroin, shaken three minutes, and centrifugalized*. The film obtained was then smeared, stained, examined, and compared with the undigested smear. The total time of digestion was not over ten minutes in any case, including the time the specimen was in the shaker. The total number of examinations made according to the above described procedure was 327, from which 111 positive results (34%) were obtained altogether. By the direct method a total of 107 were found positive, while the digestion method gave a total of 105 positives only; but 4 positives by the digestion method had been previously negative by the direct method, while 6 positives by the direct method were negative by the digestion method.

When digested for a short period only, as outlined above, the appearance of the specimen after smearing and staining did not differ greatly from the same specimens smeared directly after shaking and without digestion. Some debris was of course eliminated, but sufficient was left to make certain that the digestion was not complete. For this reason it was decided to try a longer period of digestion, and the following procedure was carried out:

PROCEDURE 2. After shaking and examining the specimen, it was then treated with antiformin (2 to 3 cc) and allowed to stand over night, usually about 20 hours, without shaking. The ligroin was then added, a three minute shaking given, after which the specimen was transferred to the centrifuge, whirled, and the film smeared and examined. This procedure was carried out with 44 specimens, of which a total of 20 (45%) were finally proved to be positive (16 being positive by the direct method and 20 by the digestion method). This long period of digestion gave very beautiful results, the field being almost wholly free from debris, and the tubercle bacilli staining rapidly and well. When the digestion is carried as far as possible with subsequent centrifugalization, any undigested tubercle organisms present are concentrated in such a small area that they must surely be discovered. Until one is accustomed to the method some delay in focusing occurs, owing to the fact that digestion is so complete that but little is left upon which to focus.

The greatest drawback to the foregoing procedure is the length of time necessary for complete digestion, which necessarily delays the report. The attempt, therefore, was made to shorten the digestion period.

* Any undigested material collects in a thin film between the ligroin and the digested sputum.

PROCEDURE 3. To this end it was determined to try the effect of shaking the specimen with antiformin for a 15 minute period, and then allowing the specimen to stand for one hour before adding the ligroin and centrifugalizing. Fifty specimens were treated in this manner. Of these 50, a total of 26 specimens (52%) were positive, 21 by the direct method and 26 by the digestion method. One specimen not included in the above-mentioned figures showed no bacilli on the direct method, and but two acid-fast organisms after digestion. This specimen was reported as suspicious, and another specimen requested.

While the smears obtained by the third method show that digestion is not as complete as by the over-night method, in no case was there sufficient debris to cause trouble, while the results obtained were fully as good.

Unfortunately, owing to a limited laboratory force, it was impossible to have the direct smears checked by a second diagnostician. The objection may be raised that further searching of the direct smears might have resulted in a few organisms being found. This is of course possible; a period of about ten minutes, however, was given to each smear before calling it negative, and it is probably true that this is the average time devoted to one smear in the majority of laboratories, since in many laboratories but one man is available for sputum work.

From the results of our experiments we believe that quick digestion by means of the shaking machine (procedure 3) gives as good results as over-night digestion. While the total number of specimens examined by third method were hardly sufficient to base a definite opinion on it is our believe that the method possesses advantages and gives promise of greater accuracy than can be obtained from undigested specimens.

Section of Municipal Health Officers

SOME PRELIMINARY NOTES ON THE USE OF STREPTOCOCCUS VACCINE AS A MEANS OF PROPHYLAXIS AGAINST SCARLET FEVER.*

By EDWARD T. BIWER,
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In dealing with the contagious disease situation in the city of Chicago, the Health Department strongly urges the hospitalization of all cases of scarlet fever and diphtheria; to that end the city maintains a contagious disease hospital in which are treated all cases of diphtheria seeking hospital treatment, while the scarlet fever cases are taken care of in the Cook County Hospital.

In the city contagious disease hospital, we have been constantly face to face with the problem of scarlet fever developing among our diphtheria patients through the admission of cases of scarlet fever in the incubation stage which have been diagnosed as diphtheria outside, and through the admission of unrecognized mixed cases.

At a meeting of the department of health early in March of the current year, prophylaxis against scarlet fever by means of the injection of killed cultures of streptococcus, isolated from the throats of persons sick with scarlet fever, was suggested by Dr. Hektoen of the Memorial Institute for Infectious Diseases, who told of the work being done in Russia along these lines. As a result of Dr. Hektoen's statements it was decided to try this method at the city hospital.

The streptococcus vaccine used by us is prepared by Dr. Weaver of the Memorial Institute and differs from that in use in Russia only in the method of preparation. In Russia the vaccine is prepared according to the method of Gabritchewsky, who used a concentrated bouillon culture of the streptococcus isolated from persons ill with scarlet fever, and killed by heating to 60° C. Weaver and Tunnicliff have found† that the injection of streptococci killed by heat is without satisfactory result in the treatment of streptococcus infections, and decided to test the efficacy of

* Read before the Section of Municipal Health Officers of the American Public Health Association, Milwaukee, September, 1910.

† Journal of Infectious Diseases, Vol. V, No. 5, page 589.

streptococci killed by suspension in chemically indifferent agents. They accordingly proceeded as follows: The streptococci were grown on blood-agar slants in ordinary test tubes; after 24 hours at 35° C. the water of condensation was removed and the bacteria on the surface suspended in a sterile 25% solution of galactose. The suspension was kept in the incubator at 37° for 72 hours, shaken several times in the interval, after which the suspension was distributed in small test tubes and desiccated in vacuum over calcium chloride, sealed, and placed in the refrigerator. Sterility is always determined by culture. The small test tubes contain one dose each of 250,000,000 or 500,000,000 streptococci.

Our method of procedure is to inject each patient admitted to one of our two wards with an initial dose of 250,000,000 streptococci on the day of admission; seven days later a dose of 500,000,000 is administered, to be followed after another seven days, if the patient has not been released from quarantine, with a final injection of 750,000,000. The site for the injection is invariably the left side just above the crest of the ilium. The killed cultures are suspended in 2 cc. of sterile normal salt solution and injected subcutaneously.

Since the majority of our patients are admitted while in the acute stages of diphtheria, we cannot determine very accurately the degree of general reaction to the injections, as evidenced by the temperature, pulse, etc. With regard to the local reaction, we have found in practically all cases that the site of injection was slightly indurated and tender for a period of twenty-four to forty-eight hours. A few cases develop abscesses at the site of injection, but they can be accounted for as errors in technique.

Immunization was begun April 1 of the current year (1910), since which time 498 cases have been admitted to both wards; of these 143 have been injected with the streptococcus vaccine. Of the 143 injected, 4 cases have developed scarlet fever, as follows: Case "A", admitted April 4-'10, developed scarlet fever April 10-'10; case "B", admitted April 17-'10, developed scarlet fever, April 21-'10; case "C", admitted May 10-'10, developed scarlet fever May 13-'10; and case "D", admitted July 19-'10, developed scarlet fever July 25-'10. All cases of scarlet fever developing within six days following admission, and probably in the incubation stage of the disease when injected, seemingly substantiated Smith's opinion* that a relative immunity is established by the end of the first week following the first injection, while an absolute immunity exists after the third, and usually after the second, injection. As has been stated, the majority of our cases are admitted while in the acute stage of diphtheria, which fact renders it difficult to arrive at any very satisfactory estimate of the general systematic reaction

*Boston Medical and Surgical Journal, Feb. 24, 1910, page 243.

to the streptococcus injections, since these cases are injected with antitoxin at the same time, the reaction to which effectually clouds any reaction that might result from the streptococcus. Yet a fairly large percentage of cases do not require antitoxin, and from these we formulate the conclusion that, in the vast majority of instances, there is no very marked general reaction. This will appear from the following: 56.9% of cases required the administration; of these the temperature was increased in 36%, decreased in 48%, and did not change in 16%. The other 43.1% of cases which were injected with streptococci did not require the use of antitoxin, and resulted as follows: Increased temperature in 5.4%; decreased temperature in 86.8%; no change in 7.8%. When the second and third injections were given, no antitoxin was used.

Where 500,000,000 streptococci were injected, we obtained the following results: Temperature increased in 36%, decreased in 48%, no change in 16%. The injections of 750,000,000 increased the temperature in 9%; the temperature decreased in 75.7 %, and made no change in 15.3%

Smith* gives an interesting review of the use of this vaccine in Russia, where all the children in several of the small villages were vaccinated, following outbreaks of scarlet fever, with very encouraging results; the percentage of cases of scarlet fever in vaccinated villages ranged from no cases to 8.3%, while unvaccinated villages ranged up to 70.6% of cases of scarlet fever.

We have been unable in our short series of cases to find any contraindication to the use of the vaccine and regularly use it in cases desperately sick with diphtheria.

We may say, in passing, that the vaccine seemingly modified those cases of scarlet fever developing after the injection, inasmuch as our four cases were all of a very mild type.

While our observations as to the value of the streptococcus vaccine has not extended over a wide enough range of cases to form any very definite conclusion, we feel that the results we have attained justify us in continuing the work, especially since the Russian reports are so flattering as to the efficacy of the vaccine.

Our hospital is not the best place for experimentation in that we obtain a very meager history of the cases admitted, and, in a large majority of instances, are utterly unable to determine whether or not the children have had scarlet fever or have been exposed to it. The proper place would seem to be out in the field of the medical inspector who should use every endeavor to inject, with permission, every child in districts where scarlet fever makes its appearance.

* Boston Medical and Surgery Journal, Feb. 24, 1910.

The Massachusetts Association of Boards of Health

JULY—QUARTERLY MEETING

Boston, Massachusetts

The quarterly meeting of the Massachusetts Association of Boards of Health was held on Thursday, July 27, 1911, at the Hotel Brunswick, Boston, Dr. Henry P. Walcott, the President, presiding.

The following persons were elected to membership in the Association on recommendation of the Executive Committee:

C. Hammond, of Hanover.
A. R. Crandall, of Taunton.
R. D. Dean, of Taunton.
D. J. Mehegan, of Taunton.
W. J. Randall, of Chelsea.
G. B. Fenwick, of Chelsea.
E. C. Kelly, of Boston.
C. R. Felton, of Brockton.
H. N. Spring, of Leominster.
Pierre Brunelle, of Lowell.
A. C. England, of Pittsfield.
F. J. Hagan, of Chelsea.
P. A. E. Sheppard, of Boston.
Wallace Hatch, of Providence, R. I.

THE SCORE CARD SYSTEM OF DAIRY INSPECTION FROM THE NATIONAL STANDPOINT.

By Dr. GEO. M. WHITAKER,
United States Department of Agriculture, Washington, D. C.

The duties of the market milk section of the dairy division of the Bureau of Animal Industry are to study the sanitary production and handling of milk, to investigate problems of transportation and distribution, to examine ordinances, laws and methods of inspection, and then to disseminate this information by printed literature, correspondence, lectures, personal visits and suggestions, and exhibitions of various kinds.

This work is wholly educational. The dairy division has no police powers, and no authority for issuing and enforcing regulations. The federal government under the national pure food law, so-called, can prosecute those who produce or sell adulterated milk when it is an article of interstate commerce, but the dairy division has nothing to do with that law.

So far considerable of the work of this section has been in connection with the score card system of inspection. The dairy division does not claim authorship of this system, but yet is practically the father of it, having originated the movement which has made the system widely known and in general use. Representatives of the market milk section have visited the leading cities in the country, giving object-lesson demonstrations of the score card and explaining its use by illustrated lectures and otherwise. This is always done on invitation of the local health authorities and is purely educational or suggestive.

What is the score card system of inspecting dairies? It is, in essence, a system of rating dairies so that we can record and allude to their conditions in specific, exact mathematical terms rather than in vague generalities. To speak of a certain dairy as "good" or "bad" is usually meaningless, because there are many standards and many degrees of goodness and badness. A dairy that scores 70 (100 being perfect) is usually satisfactory. Certified dairies have scored as high as 95. Although there is a great difference between 70 and 95 this wide range of conditions can be classified in one group as satisfactory or good, while the score of each dairy tells its exact condition. The score cards in general use itemize in minute detail the various conditions necessary in producing milk,

assigning a certain number of points to each item. Each item is rated by itself independent of the others and the total gives the score of the dairy as a whole. The final rating is the sum of about 60 different judgments.

The score card system of dairy inspecting has made wonderful progress during the past few years. It is now in use by about 150 cities and large towns (for in many parts of the country milk legislation is purely a matter of municipal control.) It has been formally introduced by state officers as a portion of their system of inspection in fourteen states, and the recent sessions of the legislatures in Idaho and Utah adopted it in state enactments. Eighteen agricultural colleges give instruction in the best methods of securing better market milk and the score card system of inspection. Eleven large milk dealers use this system of inspecting the dairies from which they buy their supplies. Several of these dealers are located in Boston and they have done commendable work in improving the supply of the city.

The score card system of inspection has been the subject of several publications by the department of agriculture and is now generally recognized in dairy and medical literature. The Journal of the American Medical Association has spoken approvingly of it and at the Milwaukee meeting of the American Public Health Association, Dr. Thomas of the Baltimore health department said:

> "The sanitary condition of dairies and stores is best recorded by means of the score card system whereby a dairy receives a certain mark according to its merits, 100 for perfection being used as a basis for scoring. Of the cities replying to the questions 63% use the score card for dairy farms, 35% use them for local dairy depots and stores, and 30% use them for all inspections. It is due to the efforts of the Dairy Division of the Bureau of Animal Industry of the United States Department of Agriculture that the score card is so widely used. Probably the best score card is the one adopted at the last meeting of the Official Dairy Instructors' Association. This card is self explanatory, applicable to all sections of the country, and its adoption by all dairy inspectors would effect a much desired uniformity in scoring by this method."

John Spargo, in his book "Common Sense of the Milk Question", alludes to the "bewildering increase" in the number of score cards and recommends a uniform standard. In a paper read before this Association at its January meeting, Professor Gunn alluded to the fact that at the present time there are various forms of score cards in use and said " it is difficult if not impossible to compare results of scoring in one city with those of another." The score card of the U. S. Department of Agriculture is the one that has been generally adopted and it is in almost universal use. In a few cases the Pearson or Cornell card, so-called, is still in use

and the Bordens have a form of their own. The Pearson card was devised years ago by Professor Pearson, now Commissioner of Agriculture in New York, and was an important progressive step, but Professor Pearson himself now endorses the standard national card. This card is the result of an evolution. Actual use in the field has resulted in changes from time to time, and while not yet perfect it is acknowledged to be the leading and best card there is. It is endorsed by the National Association of Official Dairy Instructors.

One source of apparent variation in the score cards in use is due to the fact that several cities are still using the earlier forms of the dairy division score card. Two of the first cities to adopt this system were Richmond, and Norfolk, Virginia, and they are still using the forms first adopted. Chicago is using another form but not the latest. Another cause of variation in score cards is due to changes made by local officers who think they can improve the standard card, and because of this we frequently find places using the federal score card system but with modifications. In some cases this is desirable; for instance, the monitor roof system of barn ventilation is not the perfect system in northern latitudes on account of its withdrawing air warmed by the cows' bodies at a too rapid rate, while under southern conditions such a system is unobjectionable. The health officer of the District of Columbia considers the health of the cows of so much importance that he has a separate card for this item and removes it from his dairy score card, which is otherwise the same as the national card. The standard score card allows two points for the thorough washing of utensils, two more if they are scalded, and one more if they are sterilized in live steam. This has been changed in Boston so as to allow the whole five points for "thoroughness of washing," giving nothing for scalding and sterilizing in addition to washing. Those of us who have had something to do with evolving the score card believe that the best way of handling milk and utensils is in a house or room devoted exclusively to dairy work and that washing pails and cans in the kitchen sink with the domestic utensils is not the ideal plan; consequently a point is allowed on the score card for hot water or steam "in the milk house, not in the kitchen;" but on the Boston card this clause is erased and a point is allowed for hot water or steam even in the kitchen. The standard score card allows three points for inverting utensils in pure air while drying and not in use, for the purpose of preventing contamination from dust and flies. On the Columbia, South Carolina, card the words "and sunlight" are inserted so that the three points are allowed for inverting the utensils "in pure air and sunlight". This would prevent the use of a modern sterilizer. Other variations could be mentioned. There is

therefore a superficial appearance of accuracy in Mr. Spargo's allusion to the "bewildering" number of score cards, though the national card is evidently the standard and is in general use. The growing desire for a uniform score card so that conditions in various places can be better compared with each other than at present will unquestionably increase and have a tendency to reduce the number of minor local changes, and to concentrate upon the Department of Agriculture card as a whole.

In addition to a uniform card, uniform methods of scoring are desirable, and to bring this about the dairy division stands ready to render what assistance it can in standardizing this work. Some places get pitched on too high a key and this is a common fault with inexperienced inspectors. While such high scores are as valuable as any for expressing differences between different dairies contributing to the same supply and for educating producers, they are worthless for purposes of comparison with other cities. A few reports come to me in which many of the dairies score in the 80s and 90s. Such results are always to be viewed with suspicion, for dairies entitled to such high rating are few and far between. I found an average of 40.06 in an investigation of the Chicago milk supply, and taking the country over I imagine that that figure would come nearer to expressing average conditions than the higher ones.

The comparison of average scores of different cities may be improperly used, as for instance where health officers and newspapers do not care how bad local conditions are, provided they are better than the conditions in a neighboring city; when a person is downright filthy it is nothing to his credit that a neighbor is even dirtier. But there can be an advantage in studying relative conditions. Such an investigation gives the health officer a broader view of his work and of the local situation, and tends to restrain yellow journalism—where it exists—from exaggerated, one-sided or hysterical statements. As an illustration:—The condition of dairies supplying milk to Boston is represented by the figure 45. The condition of the dairies furnishing Chicago's supply a year ago was represented by 40. I recently visited a number of dairies in Lancaster county, Pennsylvania, and found an average condition represented by 39. A large number of inspections in a prominent city in the middle west gave an average of 33. The first thorough scoring of Richmond, Virginia, dairies resulted in an average score of 36.4. The Louisiana State Board of Health recently scored 345 dairies supplying 51 towns; the average of the highest scores was 44.4, of the lowest 17.2, and the general average was 31.6. This comparative information is interesting and valuable. It shows that while the Boston supply needs to be greatly improved before it can be called satisfactory, it does not merit unqualified condemnation and has many

commendable features. This statement is further emphasized by the fact that in the Chicago case 12% of the dairies were below 30, while in Boston less than 3% were in this low class.

From the standpoint of the health officer the score card system brings results in the shape of improved dairy conditions and brings these results quicker and easier than do other systems of inspection. The files of cards that have been filled out give volumes of information and make admirable office records. In the larger cities where many inspectors must be employed some of whom may be less thorough than others, this system furnishes a good method of following their work; if the inspector is required to leave with each dairyman a carbon copy of his score there is a strong probability that the dairy was actually visited and that some attention was paid to each item on the card.

From the standpoint of the producer the system has marked advantages. He can feel that he has received an accurate and impartial score, for with everything written down in black and white the opportunities for error and favoritism are small. If the inspector has tact and talks over with the dairyman the various ratings on the card and the reason for the score he makes, the dairyman becomes interested and is helped by means of the card. If the inspector has sufficient skill to make not only a reasonably accurate score but also some suggestions, he becomes a friend and helper of the dairyman and his visits are looked forward to with satisfaction. The score card system is simple and easily understood. In some places the health authorities have made too many and too complex regulations. They have studied what is necessary in the production of sanitary milk and then have embodied these essentials in a dairy law. If such a code were literally obeyed it would result in perfect milk, which is impossible and the health authorities know that the law will not and cannot be enforced. The dairyman however looks at the formidable code of fifteen to twenty pages with feelings of perplexity and irritation, knowing that he cannot comply with its requirements. Rating a dairy according to its merits does away with this irritation, and as the dairyman makes improvements he has the satisfaction of seeing his score increase. The score card protects the dairyman from the faddist who can see nothing but the tuberculin test, a cement floor, or white milking suits.

The score card tends to prevent misunderstandings, to bring nearer together health officer and producer, and to do away with the feeling that the inspector is out to interfere with the milk business and to demand expensive changes. The relations between producer and inspector should be such that the visits of the latter may be desired and even anticipated

with pleasure. The health officer of Indianapolis, Indiana, says he is frequently called on the telephone by dairymen who desire to have an inspector sent to their premises, having made some improvement for which they desire credit on their score-card.

Investigating conditions in different cities is interesting from the standpoint of a study of human nature, which is similar everywhere. All milk producers are in a general state of unrest and feel more or less antagonism towards health officers. I recently came across a newspaper article containing the following sentences:—"There is danger of a milk famine owing to the strictness with which the sanitary authorities are enforcing the so-called pure milk regulations" * * * "The crusade for germ-free milk has been so vigorously pushed that the price of the bottled product has gone up two or three cents a quart in the last few years." * * * "Dairy herds are rapidly and considerably decreasing under what the farmers call the incessant harassment of the milk inspectors." * * * "Thousands of unjust convictions have been recorded against dairymen owing to the variability of fat in pure milk, for which the cow and her Maker alone are responsible." These complaints do not come from Massachusetts or any other state in this country, but from London, England.

Part of the trouble between producers and health officers arises from the verbose, drastic, or impracticable, laws which exist in some cities. The ordinance of a southern city says that all stalls and dairy premises "shall be kept in absolutely perfect sanitary and hygienic condition"; that the milk depots shall at all times be kept "immaculately clean" and that the health officer shall have power to adopt such regulations as he may deem proper and necessary "to compel perfect hygienic and sanitary conditions." The reaction from unwise laws unwisely enforced sometimes has led milk producers to deny universally recognized principles of science. A grand jury of milk producers in Kane county, Illinois, in their report to the county court reported a resolution to the effect that the tuberculin test was worthless and the judge ordered the resolution spread upon the court records. Another cause of friction between milk producers and health officers grows out of the changing definition of the word "clean" which producers do not fully understand. At a recent meeting of the producers for the Boston market a resolution was adopted calling attention to "the proverbial neatness of the New England farm family." That which was called clean a few years ago may be considered untidy today. The methods of the "clean" surgeon of half a century ago would convict him of malpractice today. In domestic work the feather duster age has passed, to be succeeded by the vacuum cleaner age in which the dust is sucked into

a removable receptacle and taken from the room. These changing ideas as to cleanliness should be explained to the milk producers. The work of improving the city milk supply should be largely educational.

The tendency to agitate for unsound laws is not confined to any one locality. At a recent session of the Indiana legislature a law was passed prohibiting the state veterinarian from applying the tuberculin test to any animal unless there was physical evidence of the existence of tuberculosis. The law also provides that if the owner of cattle objects to the state veterinarian's claim that there is physical evidence of the disease, the veterinarian can "call two farmers from the township whose judgment with reference to whether such cattle have physical evidence of tuberculosis or not shall be final."

Another common condition which knows no local limits is the existence of more or less sensationalism in the daily newspapers which exaggerate and misrepresent bad conditions, unduly alarm the consuming public, tend to injure the producers, and sometimes embarrass the health officer who is making progress that is all the more sure because it is somewhat slow.

One of the difficult things in connection with my work is to express conditions accurately and judicially without giving an opportunity for sensationalism and one-sided attacks on producers, dealers, or health officers on the one hand, and on the other without lulling a community into apathy and a false sense of security because conditions are relatively creditable, and without aiding the development of a foolish local pride because some other city has inferior conditions. A man toiling up a hill may be far distant from the top with a great deal of hard work before him, others may have advanced further than he has, and still he may be entitled to much credit for the progress he has already made, and for the effort he is putting forth to advance still higher and because he is ahead of many. Words of such extremely opposite meanings as up and down can be applied to him, depending upon whether we look down upon the toiler from a position above him or gaze up at him from the foot of the hill. A mathematical statement—like the figure on a score card—telling precisely how far one has advanced, is the only satisfactory and accurate way of describing his position.

STERILIZING STATIONS IN DAIRY DISTRICTS.

By Dr. CHARLES E. NORTH,
30 Church St., New York City.

I believe the people of this country have been educated to the point where they desire to have better milk. Many of the plans which have been proposed for securing this milk have as their basis the transformation of the dairy farmer into a sanitary expert. I maintain at the outset that the present generation of dairy farmers cannot be transformed into sanitary experts by any method whatsoever. It may be that that portion of the next generation of dairy farmers graduating from agricultural colleges may be fitted to be entrusted with delicate bacteriological operations similar to those of a surgical operating room, and that they will posses a knowledge of sterilization and antisepsis which will protect our milk supplies from heavy bacterial contamination; but one who is familiar with the present nature of the average dairy farmer knows that these men are not fitted to be entrusted with such operations.

I do not desire to minimize the value of the score card system or of inspection; in fact, I believe that the use of these two methods represents perhaps the utmost that public health officials can do today to bring about the desired reforms.

Among other methods which have been suggested to remedy present conditions the most conspicuous are those of the certified milk commissions. These commissions have demonstrated by several years of evidence that their proposition is one which gives us the most ideal milk, and it is certain that the certified milk of today represents about the acme of milk perfection; but I assert that no one can imagine it is a possible thing for the mass of our dairy farmers to become certified milk producers. There are a number of reasons against such a proposition as this. In the first place they have not the intelligence, and in the second place they have not the capital. If we want to look for a further reason we must turn our eyes toward the market and admit that the mass of milk consumers will never pay the price for certified milk.

In a situation of this sort it looks to me as if we were blindly urging our reforms unless we are prepared to step forward with some practical method for milk production which is feasible for adoption by the masses of milk producers, and which will give us clean milk at a price that is within

the reach of the masses of milk consumers. It is a fact that there are really only two parties to this milk contract; one is the milk producer and the other is the milk consumer. The large milk dealer is a necessary evil. He really represents an express company, a means of collection, transportation and distribution; he has little to do today with milk production as a whole. Physicians and health officers are not really parties to the contract. The party of the first part is the milk producer, the party of the second part is the milk consumer; and the reform for which we are looking must be something which is satisfactory to the principals.

Pure milk production is really a commercial proposition. Any plan to improve quality which does not carry with it an increase in price does not correspond with the well known laws of economics. For the health officer to urge upon farmers the necessity of improvement in quality, without pointing out to the farmer any hope for an advance in price, is not a common sense thing from a business standpoint. I assert, therefore, that we must expect to pay better prices if we expect to have better milk. What we all want to know is, how much better must our milk be to be fit to use, and how much is it going to cost us? That is the question that I, with a number of associates, have set myself to solve.

Eleven years ago I bought a farm and devoted myself exclusively to the production of certified milk. Among other facts which I discovered was the important one that I could produce good milk in old barns. After having spent many thousands of dollars in building ideal sanitary dairy buildings I was amazed to find that I could produce a milk in some of the oldest buildings on the place just as good, so far as the laboratory analysis showed, as I produced in my up-to-date buildings. It was purely a question of how clean the man himself was, and how clean he kept his building; I therefore made up my mind that milk reform lay along those lines.

If one stops to think he will realize that a cow may be standing in a very dirty barn, she herself may be very dirty, and yet a little calf will run in from outside, and provided the cow's udder is fairly clean, that little calf will take his dinner and trot out of that barn with certified milk in his stomach. The reason why the calf is able to do so is because he has a very small mouth, and because he brings that small mouth very close to the source of supply. We can imitate that procedure by constructing small metallic mouths and bringing them very close to the udder; and that perhaps is the most important single step in sanitary milk production.

Very few people know how to use covered milk pails. I have been to certified daries and found men milking into covered milking pails with the pail two feet away from the cow. They don't realize that the nearer they

get the mouth of the pail to the udder the more dirt you are going to keep from falling into the pail.

In the long list of sanitary precautions which we find on our score cards we should distinguish between those which are of primary and those which are of secondary importance. I don't want to say that we should neglect anything of importance, and I don't want to say that we should not ask our dairy farmers to do everything that they ought to do; but I do say that if you can get them to do two things; first, to milk into sterile, covered milking pails as close to the cow as they can get them, and secondly, to ice their milk, you will secure a milk that is many thousands per cent. superior to the article that is being produced today, at a very slight additional cost.

Armed with the facts which I learned during my five years' experience in dairying, I came to New York and after several years of agitation interested the New York Milk Committee in raising the necessary funds to try out my scheme. They raised the money and organized a little milk company which bought an old abandoned creamery at Homer, N. Y. This creamery has been thoroughly equipped for the sterilization and washing of milk utensils, and for the cooling and bottling of milk. We have a bacteriological and chemical laboratory in the creamery. Instead of the ordinary creamery man we have a trained bacteriologist in charge. The farmers looked askance and with much misgiving and with some ridicule at these preparations, but after we had held a meeting and offered them premiums in return for following our rules of milk production they began to drift in our direction. The very first day three farmers agreed to produce milk for us and at the present time we obtain our supply from twenty farmers.

We don't ask these farmers to do very much. The trouble with all former attempts to produce good milk, as I have already hinted, is that too much has been asked of the farmer. Our idea has been to leave farming to the farmer and put dairying in the hands of sanitary experts. Don't ask the farmer to become a sanitary expert; bring your sanitation to him, control it, and supervise it and leave to him just as few operations as you possibly can. The next generation we may make responsible for a little more, but we don't ask this generation to do anything but to raise the crops and milk the cows. All dairy operations are performed by ourselves.

We don't use their polluted water supplies. I was somewhat amused at certain health inspectors when they attempted to score the dairies which supply us. The first thing they did was to score the water supply on the farms. I objected at once, as these wells were not used in connection with our milk supply. I believe nearly 60 per cent. of the dug wells

on dairy farms are polluted. I maintained that all of these farmers should receive credit for our artesian well, which was located at our central dairy house, and which was the only water used in connection with the industry with the exception of the water the cows drank. There was also trouble when it came to the question of scoring the milk houses of these farmers for our milk house was their milk house.

Our scheme is one which makes the general arrangement very similar to that of a large certified farm, where there is a central dairy house with barns scattered at intervals, except that our barns have line fences between them and are on different farms. Our shipping station is a central dairy house to which all of the farms act as tributaries.

In order to secure a sufficient supply of the right kind of milk, we offered our farmers one-half cent per quart advance over the local market price for supplying milk from tuberculin tested cattle. That part of the country has been opposed to the test for tuberculosis, because the farmers never could see where there was any money in it for them, but this offer of half a cent per quart, when they came to figure it up, seemed to pay them for the loss of some of their cows even if the state did not reimburse them. Fortunately for our proposition the state has paid them in addition, so that one farmer actually tells me that one of the most profitable things he ever did was to have twenty-three cows slaughtered for tuberculosis, since he received payment from us and from the state also. The advanced price received for his milk more than paid for the slaughter of these cows.

In addition to the premium for tuberculin tested cattle, we pay a premium of a quarter of a cent per quart for what we call sanitation. Sanitation includes, first, milking into the sterile, covered milking pail, second, cooling of milk with ice. Either this milk has to be cooled by the ice supplied by the farmer himself, or we will supply ice to the farmer at cost, or he has to bring his milk to us immediately after milking—in which case we cool it at our central station.

We have also offered our dairy farmers a premium for all milk which tests below 10,000 bacteria per cc. We found that this was perhaps one of the most valuable premiums offered. In offering it to our dairymen it was with the distinct understanding that they would share the premium with the men who milked the cows. One dairyman afterwards said that he had often told his men to wash their hands, and had often urged them to wash the udder and flanks of the cow. When they knew he was coming they usually did so, but never before in the history of his dairy had he any guarantee that they did so when he was not there. After his first month's work with us this man's premium for low bacterial counts was $36; he kept $18 and gave the other $18 to the three men who

milked the cows. He now knows that his men wash their hands even when he is not around. This shows conclusively that you must reach the man who milks the cow. The visit of an inspector to a dairy farm once a month furnishes no guarantee that during the other twenty-nine days in the month the men are going to follow ordinary precautions of cleanliness.

The man in charge of our plant informed me that the majority of our dairymen were producing milk with a bacterial count of less than 10,000 bacteria per cc., and that he could not get them any lower. Believing it possible to secure a still better milk we offered an additional and final premium to the man who had the lowest average number of bacteria per cc. during each month. As soon as we took this step the average number of bacteria in the milk to the month began to go down, and there is now each month a very warm contest between these different farmers as to who shall be the winner of this special premium.

At a recent meeting of the farmers who supply us with milk they all asserted that they were willing to do whatever they were asked to do in the way of sanitation provided they could see some financial return therefor. They disclaimed any credit for being philanthropists, stating that they were not interested in the infant mortality in cities, but only in the infant mortality on their own farms. The majority did not believe in bacteria, never having seen any, but they were willing to take our statement regarding bacterial counts and cleanliness.

On the door of our building is a bulletin board. Each dairyman's name is in the first column, and the days of the month run along the top. Under each day is the bacterial analysis of each man's milk. At eight o'clock every morning there is a crowd around that bulletin board; the farmers are comparing notes and seeing who is going to make the most money during the month, and it is a fact that if a man finds his milk showed 1,000 bacteria per cc. on one day and 3,500 the next, he invades the office and inquires of the bacteriologist why it was that his count went up.

We have been operating for more than a year. We started with only 300 quarts a day and are now producing 4,000 quarts daily. When we started it was said that as soon as the hot weather came we could not continue to place low count milk on the New York market, because our milk is thirty-six hours old when it is delivered in New York. We purposely went to a part of the country 350 miles away, so that those who were likely to criticise us could not say that we planned to secure shipping advantages. Our milk is as old as any milk that goes into New York City, but during the hottest week in July we still maintained our average bacterial standard, which is less than 30,000 per cc.

All of our morning's milk is brought to our station hot. The reason it is not cooled is because we want it as soon as possible and we cannot wait to have it cooled.. We had been led to believe that milk must be cooled as soon as it is milked. Some of our milk is three hours old when it gets to the creamery. For the first three or four hours after milking the increase in the number of bacteria is so slight that as a general thing the morning's milk tests better than the previous night's milk. The previous night's milk is, of course, iced in every case.

We have penalties for those who fail to come up to our minimum standards. For instance we substract from a man's record if his bacterial count averages over 100,000. We also substract if his butter fat is below 3½ per cent.

The milk comes to our shipping station and is bottled and cooled there. It is then put on the train and shipped to New York, and most of it now is marketed at the thirty-one infant feeding depots maintained by the New York Milk Committee in the poorer parts of the city. The rest of it goes to one of the large milk dealers, who takes all of our surplus. The cost of this milk during this summer to these stores has been 7½ cents wholesale in bottles. One reason for this is that the officers are working without salary. I therefore don't want the large milk dealers to think that I maintain that this milk can be sold for 7½ cents, but I do say that all that it is necessary to do to find out what it can be sold for is to add to the regular fixed charges which are common to all kinds of milk those premiums that we pay to the farmers, plus the extra cost of operating our sterilizing station.

We know what that extra cost is. It costs us one cent a quart to operate the sterilizing station, now that we handle 4,000 quarts a day. To operate an ordinary bottling station in the country costs half a cent per quart; while to operate an ordinary shipping station, in which milk is shipped in cans, costs a quarter of a cent per quart. Therefore I think it is fair to add half a cent per quart to the cost of this milk for the surplus or excess cost of our sterilizing station over the cost of operating an ordinary bottling station. That makes a total of one and one-half cents to be added to the cost of this milk if it had been shipped in the ordinary way. It would cost one and one-half cents more than the cost of milk as it is ordinarily produced, to get tuberculin tested milk having an average bacterial count under thirty thousand per cc.

DISCUSSION.

DR. WHITTIER. Without my knowledge or consent, a little more than four years ago I was elected milk inspector of the town of Brunswick, Me., where Bowdoin College is located. I started my official duty by visiting the dairies and by taking samples from the milkmen as they came into town. The first year the average bacterial count varied from down in the tens of thousands to as high as 27,000,000 per cc, but the average was over 1,000,000.

At my request, Dr. Whittaker, of the market milk division of the United States Department of Agriculture, came to Brunswick and visited every milk farm that furnished milk to Brunswick people, scored every dairy, and gave each milkman advice as to the best way of improving the character of his milk. The milkmen took the advice in good part, and all attempted to do something towards carrying out the things recommended. Dr. Whittaker focussed his advice especially on prompt cooling of the milk, and as a result most of the milkmen began to make arrangements to put in ice houses. The next year after Dr. Whittaker's visit the average bacterial count went down from 1,000,000 to about 700,000 bacteria per cc. The second year more of the dairymen put in ice plants and, also began to be more careful about handling their milk. As a result the average count for the third year went down to 14,000 bacteria per cc. Last year the state milk inspector came at my request, scored every dairy, and suggested further improvements. Last year's count was 94,000, showing in four years a gradual decrease from an average of over 1,000,000 to an average of less than 94,000 bacteria per cc.

In ferreting out the causes we have found many factors. The most common, I think, is the failure of dairymen to ice their milk. One man who had a persistently high count, cooled his milk in a large trough. He was a large producer, and put a good many cans of milk into this small trough. Thus, with a large bulk of milk and very little water, very little cooling took place, the temperature of the water soon reaching the temperature of the milk. Under these conditions the bacteria multiplied very fast. This man afterwards iced his milk, and his count then greatly improved. Very recently one man who had the highest score of any of the Brunswick milkmen, had at the same time the highest count. I found that the highest count of any of the twelve samples of milk that I took directly from the pail as each cow was milked, was 4,800 per cc., and the lowest count was below 1,000 bacteria per cc. From the faucets of his large mixing tank I obtained a sample of milk which showed a

count of over 3,000,000 bacteria per cc., which result indicated that the trouble was in this large tank. In fact the high count was due to the faucet, which had not been properly sterilized.

DR. KELLY. The city of Fall River is supplied with milk by 550 dairy farms all situated within a radius of twenty miles of the city. We have but one man to score dairies and the most he can do is to visit each farm once a year. The board claims that this is entirely insufficient, since he should follow his first visit with a second in order to see that his orders have been carried out.

To have the suggestions in today's papers carried into practice we must convince the press, the taxpayers, and the general public, of the value of the statements made, else they are inoperative, since we cannot otherwise secure the men to carry them into effect.

In Fall River we are still suffering from the effects of the former practice of making political appointments in the health department of men without any information on health matters and without any previous training for the position they fill. These men cannot explain to the farmer why the scoring is done and are utterly incompetent for the position in other ways. Such men are out of sympathy with the clean milk movement, they don't believe in it, and they don't understand it. We were pleased recently when the employment of future inspectors was transferred to our Board of Health and classified under the civil service.

DR. BRUNELLE. Assuming that milk is produced under improper conditions, but that it is iced properly within an hour after milking, will the milk show a fairly low bacterial count?

DR. NORTH. That would depend on the amount of dirt that got into it at the time of milking, and on the cleanliness of the milk cans and utensils. One of our farmers brought a can of milk to our station one day which proved to have 500,000 bacteria per cc. He was questioned very closely as to why milk in his other cans showed only 2,000 or 3,000 bacteria per cc. He admitted after a while that he had borrowed the first can from his neighbor, who did not have the same methods of washing and sterilizing cans as we had. Thus the difference in the bacterial content of this man's milk was due to the difference in the sterilizing of the cans.

MR. WHITTAKER. The frequency with which dairy inspection should be made should depend to some extent upon the condition of the dairy. If the health officer cannot get all the inspectors he wants, I would suggest that the better class of dairies be let pretty much alone, even if they are not

inspected more than once a year; but the men whose score is in the twenties ought to be inspected once a week, if possible, until their score is forced up to forty or above. I agree most thoroughly with what Dr. North said, that with a small top pail held close to a fairly clean udder, and with the milk cooled promptly or taken promptly to a shipping station, it is possible to produce very good milk in very poor buildings, but the average producer will be more likely to get a good result with fairly clean buildings. While we never advocate any fancy buildings, we believe that as a mere matter of economy of labor it is easier to keep a barn clean that is fairly well constructed, and which has fairly smooth walls and sides, than a building full of dust catching projections, braces, and timbers. We recognize the force of what Dr. North has said about the arrangement of the score card, for on the side of the card headed "methods" sixty points are allowed, while on the other side, headed "equipment" only forty points are allowed, so that the card allows us to emphasize to the farmer just exactly what Dr. North thinks ought to be emphasized. We try to bring that out very clearly by the arrangement of the cards and by our methods of scoring.

Dr. Davis. Is it the policy of the U. S. Depatrment of Agriculture to work with a dairyman who scores but twenty-four in an attempt to have him increase his score by persistent effort, or is it better to say to such a man: "It is impossible for you to produce clean milk." If there is an arbitrary limit of the total final score in any case, what should that limit be?

Mr. Whittaker. That is another question that cannot be arbitrarily answered, but speaking in general terms it is my conviction that where a person is as low as the twenties, he is a rather hopeless case, and with such men the best way is to shut them out of the market.

Dr. Davis. Where do you think the line should be drawn below which there would be little or no chance of securing improvement?

Mr. Whittaker. It is hard to draw an exact line and say that everything one side of the line should be cut off and everything on the other side of the line should be labored with. Much depends upon the man, upon his natural appearance, and whether he appears to be intelligent and receptive. In the upper thirties, say thirty-five or thereabouts, I should think the chances are he might be a hopeful subject for improvement.

Dr. Osgood. I would like to ask Dr. North if he can suggest any application of his theories and principles to a local board of health of a city of about 100,000.

DR. NORTH. Since our sterilizing station has been operated we have received at least ten applications from local boards of health in cities of different sizes to coöperate with them in the establishment of similar sterilizing stations in their dairy districts. I believe that this plan would have to be modified somewhat to fit conditions in various places. I understand, for instance, that in Boston the larger part of the milk supply is put on the milk trains from ordinary station platforms to which it is brought by small dairy farmers. In other words, in Boston there are no creamery or shipping stations, such as we have in New York State. Over ninety per cent. of New York's milk supply comes to such shipping stations, where it can be cooled and bottled. It is at such stations that I maintain missionary stations for preaching sanitation should be established. A cardinal feature of the scheme is to take the sterilization of utensils out of the hands of the farmer.

Small towns, where milk is delivered by wagon, should have collecting places or stations to which the milk should be taken before it is distributed. In such cases it will be necessary to get either the local health officer to act as bacteriologist or to secure some other man for this kind of work, who appreciates the importance of sanitary measures, to act as supervisor for that city. I think that the main features of the idea can be modified so that they can be used in a town of almost any size.

PASTEURIZATION OF MILK IN THE SEALED AND FINAL PACKAGE.*

By J. C. CARTER,
Boston, Mass.

Pasteurization of milk is heating it to such a degree of temperature for such a period of time as to kill the vegetative forms of bacteria. Pasteurization is not sterilization, as the temperature employed is not sufficient to kill all bacteria, particularly spore-bearing organisms. While many different methods have been devised for accomplishing pasteurization of milk, it has been employed to give various results.

In order to determine the thermal death point of a living organism, two factors are of importance: (1) the temperature to which it is exposed and (2) the length of time of the exposure. Thus, according to the determinations of Theobald Smith, we say that 60° C. for fifteen to twenty minutes will kill the bacillus of tuberculosis if moisture is present. These two factors have been recognized in pasteurization and one method which is known as "the flash process" exposes milk to a temperature of about 180°F. for a fraction of a minute, while in another process the milk is held for twenty to thirty minutes or even longer at a temperature of 140° to 160°F. In this country these degrees of temperature and periods of time of exposure have had as their object the exposure of the largest amount of milk for the shortest efficient time at the highest temperature that will not affect the taste of the milk nor destroy its cream line. To the various methods of pasteurization different names have been given such as "perfect pasteurization", "pasteurization by the holding device", by "the flash process", and others. According to most systems now employed, milk is first pasteurized and then bottled. In most places there is no official control over pasteurization, the public not being guaranteed that the milk has even been pasteurized nor that it is pasteurized according to the method or exposed to the degree of temperature or for the length of time that is stated by the seller of the product. Moreover, probably a good deal of milk is bought by the public under the impression that it is normal milk when it has been pasteurized. It should also be noted that all the devices used for pasteurization are so arranged that the machinery can be

*Under supervision of the Boston Health Department.

so set that the milk is heated to a higher or lower temperature for a longer or shorter period of time than it is represented to be, and also different from what the contractor may wish it to be.

If we consider the various purposes for which pasteurization is employed we observe that the object may be broadly divided into two classes: (1) pasteurization to kill the pathogenic organisms that may be present in the milk and (2) to render salable certain milks that otherwise might be barred because of excessive numbers of bacteria, or else to make bad milk appear as good milk because of a low bacterial count. Of these the first is the legitimate, the second the fraudulant use of pasteurization.

As the result of some agitation, the dairy in which I supervised pasteurization in the final package during the past month was persuaded by scientific people who were really trying to get a good quality of pasteurized milk, to experiment with a system of pasteurization with only the legitimate object in view. To accomplish this various steps have been taken. In the first place a portion of the same raw milk which has to meet Boston's requirement of less than 500,000 bacteria per cc. is drawn into separate bottles capable of being sealed with a crimped metal-capped cork seal, similar to those ordinarily used on beer bottles. The bottles are then sealed and heated to a temperature of 150°F. for thirty minutes, as will be described later. This heating is done under my supervision as an inspector of the Boston Health Department. After I have seen that the milk has been heated to this degree of temperature and for the required time, I tag the bottles of milk as "pasteurized". In this pasteurization the following requirements are met: Milk, which without pasteurization meets the city requirement as to numbers of bacteria, is pasteurized in the sealed package, and this milk is never again exposed to contamination until it reaches the consumers. The consumer is also guaranteed that the milk has been exposed to the degree of temperature for the length of time that is stated on the label.

The process is not as simple as might at first be thought. Merely to tell the producer of milk to heat for thirty minutes at 150°F. does not at all solve the problem. Especially is this true in the sealed package. Until it became possible to put a seal of the type just described on a large-neck bottle the method would hardly have been feasable. Even with the large-neck bottle the expansion of the milk when heated is of importance. It has been found that an air cushion of some two per cent of the total volume is necessary. It is also to be noted that bottles of cold milk cannot be suddenly exposed to 150°F., and that the milk in the bottles does not reach a temperature of 150°F. when the water surrounding them does. The following method was improvised to meet these conditions:

The returned bottles, except the especially dirty ones, together with the new ones are transferred to a special rack holding twelve bottles. This rack is then started into the washing machine in such a way that the bottles are upside down. This machine is divided into three compartments. When the rack containing the bottles reaches the first compartment, which contains water heated to 120° to 130°F., together with washing soda to cut the grease, jets of the solution are shot into the bottles from a force pump. The rack of bottles then drains and it is immediately passed on to the second compartment where the bottles are rinsed by jets of water heated to 170° to 180°F. The force used in each compartment is just below that necessary to blow the bottles out of the racks. The bottles, when they reach the third compartment, are blown full of, and are surrounded by, jets of live steam. The rack of bottles when it comes from the machine is allowed to cool. From this rack the bottles are transferred by simply turning them out into the filling rack. The total time required is four minutes. The machine holds in each compartment two racks at a time, one being advanced half its length over the other. The especially dirty bottles are washed by hand after which they are run through the machine. The racks used during town delivery are washed by hand and are immersed in hot water for five minutes.

The filling of the bottles is accomplished by the regular machine employed for this purpose. A small amount of milk, some two per cent., is removed from each bottle by means of a gauge which has been thoroughly sterilized with live steam, in order that when capped an air cushion may be formed, against which the milk can expand when heated. The bottles are now capped by a special machine which fastens on a cap similar in type to the caps used on beer bottles. The bottles, in wire holders containing six each for easy handling, are then removed to the room where the water vats are installed.

These vats have a false slat bottom which keeps the milk bottles some three inches, more or less, above the real bottom, allowing a free circulation of the steam and water. When ready for use the vats are filled with water which is then heated to about 118°F. The milk at the time of bottling is between 50° and 60°F. Through a tight fitting cork a thermometer is inserted well down into one of the filled bottles. Into another bottle a thermometer is inserted in a like manner only this time the bulb is kept well up in the neck. One of these bottles is placed at one end of the vat and the other bottle at the opposite end. This is the arrangement for each vat. Live steam is allowed to run into the vats through a pipe pierced with numerous holes which is in the center of the vat and beneath the false bottom. Readings of the thermometers in the water and in the milk

bottles are taken every ten minutes until the water reaches a temperature of 150°F. When the water is heated to this temperature the steam is shut off, for the water is never allowed to rise over 153°F. By this time the temperature of the milk is 135° to 140°F. Readings are now made every five minutes and the water is kept moving so that no jackets are formed about the bottles. The caps have by this time become convex, the small amount of air in the bottles having been expelled in bubbles, so that the milk now completely fills the bottles. In a few cases there may be a little milk expelled by the expansion because of the lack of a sufficient air cushion.

When the milk reaches a temperature of 150°F., which is some fifteen to twenty minutes after the water has reached this temperature, the time is carefully noted. The water temperature is then maintained at 151° to 152°F., depending upon the way the vat has heated and upon the loss by radiation. After the milk has been held at a temperature of 150°F. for thirty minutes and a few seconds over, the water is drawn off. While the water is running off, the printed tags which are kept locked up under my own supervision are tied on the bottles. Only enough tags are counted out and brought down for the bottles that have just been pasteurized. The use of these tags will be discontinued when printed seals have been received. When the water has been drawn off to the level of the false bottom cold water is allowed to run in. By this means the heated bottles are tempered so that they do not crack when later on they are thoroughly cooled. The seals are now concave showing that a vacuum exists within the bottles. If any cap did not show a concavity the bottle would be rejected, but up to the present time none have been found. Later on ice is added to the vat, and the bottles, after cooling, are racked and removed to the car. The vats are then cleaned and made ready for the next day.

Measures of safety against fraud can be summed up in the following points: (1) the use of a bottle differing in shape from that used by this dairy for its raw milk; (2) the use of the cap which can only be put on by a special machine made for this purpose; (3) the inspection of the bottling room to see if all the sealed bottles have been removed; (4) the removal of the extra caps from the machine; (5) the counting out and putting on of the printed labels by myself or at least while I am present.

The results that have been obtained by this method of pasteurization have been very satisfactory. During the month of July, 1911, while I have supervised pasteurization at this dairy, I have been working with Dr. E. H. Schorer in the laboratory of the Department of Preventive Medicine and Hygiene of the Harvard Medical School on the efficiency of the method. We have found that the bacterial counts in the raw milk

from this dairy as delivered in the city to its customers vary from 12,000 to 50,000, while in the pasteurized milk the counts have run from 800 to 6,000 as delivered, showing an efficiency of about 90 per cent. When kept at 40° F. the bacterial count on pasteurized milk increases from 6,000 to 1,120,000 in fifteen days if the bottle is shaken on receipt. When kept at 50° to 60° F. the bacterial count increased from 3,500 to 6,000 in twenty-four hours and to 44,000 in seventy-two hours and the milk was sour in one hundred and forty-four hours. When kept at room temperature the count increased from 6,000 to 19,200,000 in twenty-four hours and the milk was definitely coagulated. At 100° F. the milk was coagulated in twelve hours.

Whether 150° F. for thirty minutes is the best degree of temperature and length of time of exposure has not been fully determined and it is very likely that the whole question will have to be investigated for pasteurization in quart bottles. However, it has been determined that not all types of ferments are destroyed. There is no cooked taste to the milk. To the palate it seems to be somewhat richer but the cream line is not nearly so visible as it is in the raw milk.

The milk seems to coagulate on ageing and putrefaction does not appear to occur any earlier or more frequently than in other milks.

The particular process of pasteurization outlined is only temporary, for already steps have been taken to install a continuously working machine, but even by the method employed during the past month it would have been possible to pasteurize relatively large quantities of milk in the final package.

My thanks are due to Dr. E. H. Schorer, of the Department of Preventive Medicine and Hygiene of the Harvard Medical School, for his criticism and help in preparing the material for this paper.

Notes and Reviews*

PUBLIC HEALTH NEWS AND NOTES

By B. L. ARMS,
Boston, Mass.

New Health Regulations in Louisiana.† Among the regulations passed by the State Board of Health during the past few months are: Abolition of the public drinking cup; regulations for the screening of all food stuffs exposed for sale; abolition of the common roller towel; provision for antitoxin for the worthy poor and the tuberculin test for all dairy herds.

Health Exhibit Train.† Dr. Oscar Dowling, President of the Louisiana State Board of Health, last November started a campaign popularly known as the "Gospel of Health on Wheels."

The train consisted of two coaches, loaned by the railroad, and a Pullman. These cars were transported free of charge by the railroads. One of the coaches contained exhibits relative to many infectious and contagious diseases, arranged with special reference to their educational value. The following were dealt with: Tuberculosis,—human and bovine, typhoid, smallpox, hookworm, pneumonia, gonorrhea and syphilis. The principles of oral hygiene were also illustrated.

The second car contained models ranging from a dairy and slaughter-pen to household utensils.

The third coach was a Pullman owned by the Board of Health and utilized as a home by Dr. Dowling and his associates. The name of this car "Educational and Inspection" conveys the entire story.

The work as a whole was organized into five divisions, each in charge of an expert. Most of the inspecting was done by Dr. Dowling who, in seven months, visited 358 dairies, an equal number of slaughter-pens, markets and bakeries, hundreds of restaurants, hotels, drug stores and school houses, and every court house and jail in the state but two. Dr. Dowling thus knows from personal observation the sanitary condition of every city and town in Louisiana. Lectures were given both day and evening.

*Editor's Note. Readers are urged to send public health notes of interest to the Editor by whom they will be distributed to the proper reviewer. The sender's name or initials should appear under such notes.

† From notes furnished by Agnes Morris, Baton Rouge, Louisiana, State Organizer School Improvement Leagues.

The record shows that about 300,000 people saw the exhibits and heard the instructions relating to them; that 200,000 attended the evening lectures; and that many thousands of women and children attended the morning and afternoon lectures. The visit of the train with the exhibition and lectures, by creating a desire to clean up, accomplished its purpose.

At the close of the state campaign, during which they traveled 7,000 miles, they still had a mission to perform and responded to an invitation of Dr. W. A. Evans, Chairman of the Section on Public Health of the American Medical Association, by taking the exhibit to the annual meeting at Los Angeles. The larger cities visited were: San Antonio, El Paso, Los Angeles, San Francisco, Salt Lake City, Omaha, Denver, Chicago, and Memphis. The routes followed were over the Southern Pacific, Union Pacific and Illinois Central railroads which furnished the transportation.

The health exhibit train will be remembered as one of the most successful incidents in the new movement for sanitation

The Right Way*. The following notice from the Kinston Free Press is reproduced to illustrate what we think is the proper way to handle the smallpox situation where the local authorities are afraid to pass a compulsory vaccination ordinance:

SMALLPOX IN TOWN.

"We hereby give notice to the citizens of Kinston that Rev. A. H. Butler, residence Tower Hill Road, has smallpox. The last Legislature repealed the quarantine law as to smallpox and made no provisions for free vaccination. The law was repealed at the suggestion of the State Board of Health, the reasons being: First, that the cost of quarantine was too great, the same costing the State over one hundred thousand dollars a year; that quarantine gave to those who did not care to protect themselves by vaccination a feeling of security. It has been demonstrated hundreds of times and in hundreds of places that vaccination secures immunity from smallpox. A well cared for vaccination gives the individual very little inconvenience. All those who desire protection can get it. Those who do not can take their chances.

(Signed), A. L. HYATT, City Physician."

This is certainly straight from the shoulder and puts the question squarely up to the people.

Hookworm and its Prevention. The August Bulletin of the North Carolina Board of Health is a symposium on hookworm disease and shows not only what has been done, but what is even more to the point, what can be done anywhere.

* Bulletin of the North Carolina Board of Health, April, 1911.

DATA FROM WATER F

CITY	Population	Source of Supply	Method of Purification	Average daily Consumption (Million Gallons)
Albany, N. Y.	100,700	Hudson River.	16 rapid sand, 8 slow sand Filters and Disinfection.	22.8
Cincinnati, O.	364,463	Ohio River	Rapid sand filters using lime and iron as a coagulant.	49.3
Columbus, O.	181,511	Scioto River	Water softening and mechanical filtration.	15.7
Harrisburg, Pa.	70,000	Susquehanna R.	Mechanical Filtration.	8.5
McKeesport, Pa.	42,694	Youghiogheny R	Water softening and mechanical filtration.	4.0
New Orleans, La.	373,000	Mississippi River	Rapid sand filters using lime and iron as a coagulant.	14.4
Toledo, O.	170,000	Maumee River	Mechanical filtration.	17.2
Washington, D.C.	348,460	Potomac River	Sedimentation with slow sand filters.	63.0
Youngstown, O.	80,000	Mahoning River	Mechanical Filtration, using Sulphate of Alumina.	8.8

NOTE.—*The high numbers of bacteria noted at Columbus were caused by "after-growths" following treatment wi
‡Death records in New Orleans included "Non-residents."

OM WATER PURIFICATION WORKS—May, 1911.

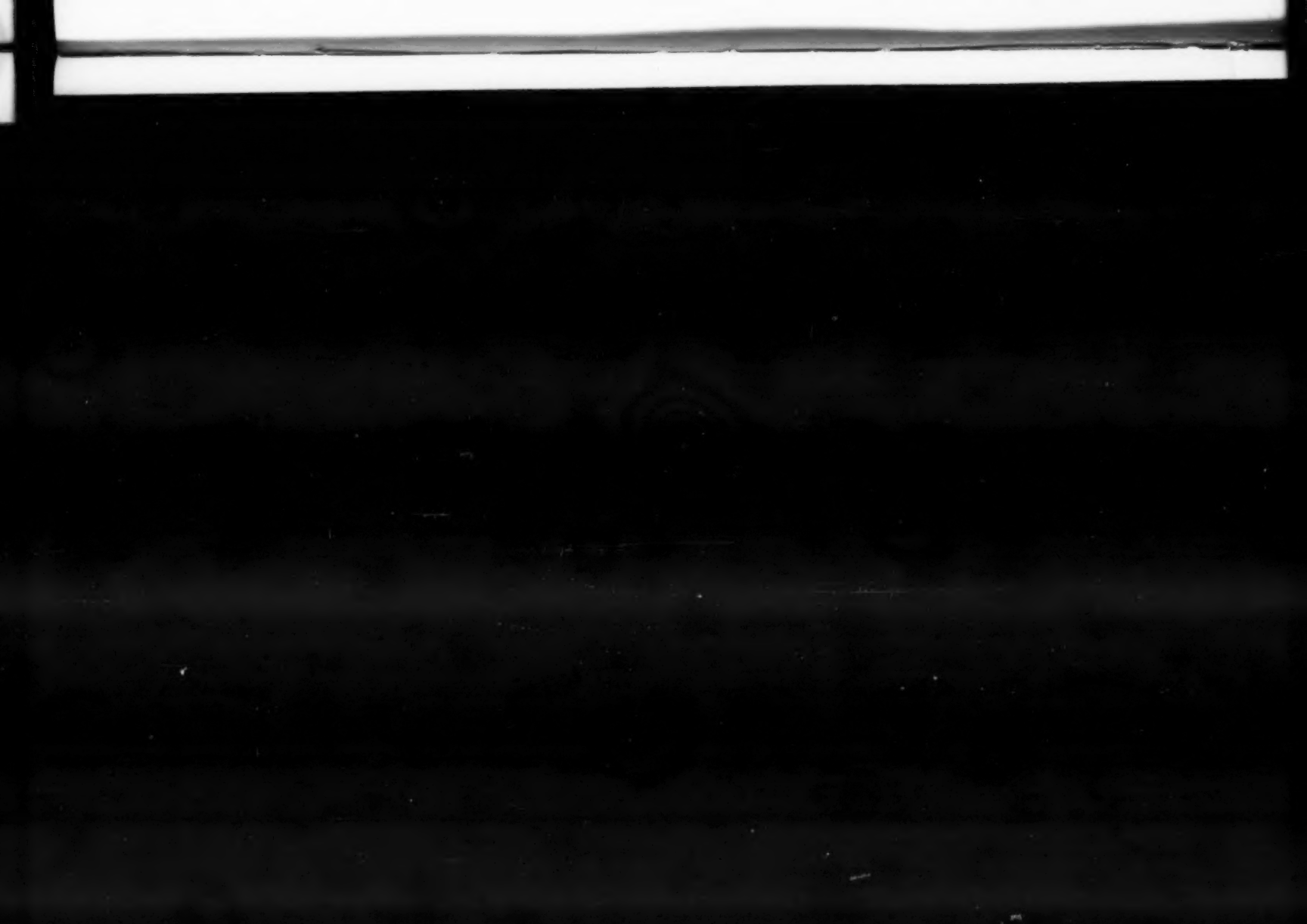
	Average daily Consumption (Million Gallons)	Washwater (per cent.)	Sedimentation Basins.						Parts per 1,0			
			Settling Basin			Coagulation Basin			Unpurified Water			
			Period in Hours	Effluent		Period in Hours	Effluent		Turbidity	Color	Total Hardness	Turbidity
				Turbidity	Bacteria per c. c.		Turbidity	Bacteria per c. c.				
Filters	22.8	2.4	17.	7	18,500	Combined with the sedimentation.			9	28	71	0
ne and iron	49.3	4.1	48.	18	665	10	12	165	55	...	78	0
nechanical	15.7	1.8	18.	4	375	Combined with the sedimentation.			61	32	256	0
	8.5	1.4	6.	* ...	.....	1.5	.....	28	24	4	35	0
nechanical	4.0	0.6	20.	...	2	Combined with the sedimentation.			...	...	190	0
ne and iron	14.4	0.8	4.5	425	1,800	12	40	100	475	10	...	0
	17.2	2.5	7.5	8	402	Combined with the sedimentation.			82	40	...	0
and filters.	63.0	0.5	96.	10	109	..	..	..	10	0	...	0
sing Sul-	8.8	4.0	3.	20	3,000	Combined with the sedimentation.			35	39	131	0

following treatment with Bleach.

W. R. Cor

Parts per 1,000,000						Nos. of Bacteria per Cu. Centimeter		No. of Deaths from		
Unpurified Water			Purified Water							
	Color	Total Hardness	Turbidity	Color	Total Hardness	Unpurified Water	Purified Water	All Causes	Typhoid Fever	Pulmonary Consumption
9	28	71	0	17	71	23,300	11	154	0	25
5	...	78	0	...	83	2,090	13	521	1	98
1	32	256	0	7	81	3,500	375*	170	1	22
4	4	35	0	0	37	5,293	18	95	1	5
.	...	190	0	0	84	432	1	51	0	3
5	10	...	0	4	...	2,200	21	643	9	72
2	40	...	0	10	...	4,850	82	206	0	...
0	0	...	0	0	...	230	8	901	8	58
5	39	131	0	0	127	31,400	404	82	0	9

W. R. COPELAND, Columbus, Ohio, Reviewer.



WATER PURIFICATION PLANT NOTES.

W. R. COPELAND, Columbus, Ohio.
(*Reviewer.*)

The Importance of Enforcing Sanitary Laws and Regulations Relating to Public Water Supplies. Few persons realize that bathing in a lake or stream may pollute the water. A still smaller number believe that persons boating or skating upon lakes and rivers may also have the same effect. As a matter of fact, however, everybody who has bathed in lakes or rivers remembers, that the cool waters cleansed his perspiring body and washed the grime accumulated from the dusty street upon his legs and feet into the water. Not infrequently, too, the association of ideas or the change in temperature excited the kidneys and intestinal tract to activity, so that it was found necessary to urinate or deficate in the water or upon the banks of the swimming pool. Many fishermen boating upon the open waters or seated on the shore pass their idle time in chewing tobacco, and not having spittoons, spit into the water.

Stringent laws have been passed in many states to prohibit persons from dumping nightsoil upon the banks of water courses in order to prevent the spread of disease by polluted waters. Why, then, should not persons be prohibited from polluting water by bathing in it, or expectorating into it?

The Massachusetts State Board of Health and the Metropolitan Water Board of Boston thought that the matter was important enough to publish a set of rules and regulations for the sanitary protection of waters. Rule No. 14 of the edition of 1910 reads in part as follows: "No person shall bathe in * * * the Wachusett Reservoir, * * * or any other lake, pond, reservoir or stream used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution of the water supply of the city, town or water Company, etc. No persons other than a member of the said Metropolitan Water Board, its officers, agents or employes, or public officers whose duties may so require, shall, unless so permitted by regulation or permit of the said Board, enter or go in any boat, skiff, raft, or other contrivance, on or upon the water of any said

reservoir, etc. Persons convicted of violating the rules in force on the water-shed of the Boston supply are liable to a fine not exceeding $500.00 or to imprisonment not exceeding one year or both."

The State Board of Health of Maryland has also drawn up a set of rules to protect the water supply of Baltimore. Rule No. 10, reads: * * * "No person shall bathe, swim or wash in said reservoirs, nor in any influent stream within 500 yards of said reservoirs." The city water board passed some further rules of which section 902 reads: "If any person shall wilfully pollute the water in any lake, etc., or other work constructed or used for supplying the city of Baltimore with water, by swimming, bathing, or washing therein, or by washing, or causing to be washed therein, or so near thereto as to pollute the water therein, any clothes, etc., the person so offending shall forfeit and pay a sum not less than five nor more than fifty dollars for each offense."

Where people live inland and are not provided with natural lakes the bodies of water formed by impounding river waters for municipal supplies offer a strong attraction to camping or picnic parties, to fishermen, to summer cottagers and to trolley lines or land development companies.

The question has been raised in some quarters as to why rules prohibiting such a use of the water-shed and waters in public reservoirs should be enforced especially in cases where the cities are provided with efficient water purification plants. There are at least three answers to this argument:

The first answer is, that although the natural process of sedimentation tends to purify a stream during times of low water, following a drouth the heavy rains sweeping over the banks and through the sewers wash large quantities of filth into the streams and produce such currents that germs of disease may be carried down stream for 100 miles.

The second answer is, that an increase of pollution means an increase in the amount of chemicals required to purify the water, an increase in the wages for supervision over the plant, and an increased danger of typhoid epidemics in case of accident to the purification works.

The third answer is, that such sports as bathing, boating, fishing, swimming, etc., encourage children and other thoughtless persons to congregate on the banks or in the water with the result that two or three people drown in every such body of water each year. This last item is an unfortunate item at best but it may become more than that when, as in the case of Harper's Ferry, the water has to be drawn entirely out of the whole basin to remove the dead body of a drowned man. If such an incident

should happen in a very dry season it is probable that the reservoir would not fill up again for months, leaving the city without water for household use or fire protection, and force large numbers of people to resort to polluted wells for their drinking water. How common it is in winter time to hear of one or two skaters being drowned by breaking through the ice. It might be impossible to remove the body for several weeks if there was a little current flowing to carry it under the heavier layer, and in the meantime the people would turn with disgust from a source of drinking water polluted by a dead body.

Rules for preventing bathing, boating, swimming, etc., curtail the pleasures of few and protect the welfare of the whole community; therefore such rules should be enforced.

BOOK REVIEWS.

The Dawn of the Health Age. Benjamin Moore, M. A., D. Sc., M. R. C. S., L. R. C. P. P. Blakiston's Son, Philadelphia.

This is a most "quotable" book of less than 200 pages, in excellent, direct, terse English. It contains concise, frank, almost brusque formulations of the "medical reconstruction" ideas now seething, but uncrystallized and unorganized, all over the English-speaking world. Although applying more particularly to Great Britain, the principles discussed deserve the most careful consideration everywhere.

The author addresses himself "equally to conservative and liberal, to humanitarian and economist, to capitalist and laborist, to individualist and socialist." (The author does not, it will be seen, address the medical profession. He assumes, presumably, that the "bone of contention" itself is always interested in its own fate.)

A string of quotations will best show the character of this quite remarkable book. Thus: (the italics are ours)

* * * "Hundreds of thousands of lives and millions of money can be saved every year if disease is attacked on scientific principles instead of being dallied with as at present."

"The passion for drugging and doctoring the *individual* with specific cures and quack nostrums is one of the prepotent curses of our time, while the health and well being of the *species* * * * are neglected.

"At the present moment we possess sufficient knowledge of medical science to enable us to save at least three hundred thousand lives every year in this country alone, and the saving of these three hundred thousand valuable lives could all be effected without costing the nation a single penny, but rather at the same time many million pounds a year might be saved which under present conditions are absolutely wasted.

"In the face of all this spendthrift extravagance in lives and money, we eagerly call for more scientific research to enable us to cope with disease, utterly ignoring the rich harvest which medical science has already yielded ready to be garnered all around us.

"It is true that we are still ignorant of the causes and modes of propagation of certain diseases, and attempts to discover these are in themselves most laudable; but it is equally true, and much more important, that we do know perfectly how to combat some of the direct and most common diseases, and that we move neither hand nor foot to do so, but stand benumbed and useless, as if we were a race of savages without any polity or system of government or capacity for any concerted plan of action for the national welfare.

"The problems of disease, from which radically spring all the most important problems of social reform, require now to be tackled by statesmen, and not by doctors and scientists.

"The exponents of medical science have accomplished their aims in many important directions and have laid their results before the public; they can proceed no further without concerted statesmanlike action, and it is for the public now to awaken statesmen into activity."

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"It is method more than money that we want in order to combat and conquer in our battles with disease; we must fight in the future by means of a disciplined army instead of, as at present, with an undisciplined mob, each member doing what is right in his own eyes and working at cross purposes to his neighbor."

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"With a self-satisfied air we make survey of what we term the modern advances in medicine and surgery, *as applied to tinkering the diseased individual*, and complacently the credulous public swallows the glorification, while we slumber over the thousand-fold greater achievements possible to organized effort in the wholesale eradication of disease from the commonwealth. Meanwhile hundreds of thousands of the fittest of our citizens die yearly without one effort being made to save them.

"Naturally our organized army of doctors would have to be paid, and this would cost the nation eight to ten millions a year; but this money is all paid now, and more than paid. All that is necessary is to pay it through different channels, and the advantage gained is that we shall possess, as aforesaid, an army instead of a mob.

"Needless to say, no disrespect is meant to the medical profession by designating it as a mob. That term is only intended to signify that it is entirely lacking in the first elements of organization so far as dealing with the diseases of the nation is concerned, and preserving the nation in a fit state of health."

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"Even if it set about reorganizing itself on new lines, the profession lacks those effective compulsory powers of dealing with disease which will be elaborated in subsequent chapters, and these only can be given to it by legislation.

"The problem of saving these hundreds of thousands of lives and millions of pounds of money annually is accordingly one for the public itself, led by those publicists who take an interest in medico-social problems."

* * * * * * * * * * *

In considering present systems (in England) of combating infectious diseases, systems far more developed than we have in this country as yet outside of a few of the largest centers, our author minces matters not at all. Thus:

"The Briton, in the opinion of some superficial critics, will become a slave under such compulsory conditions when his home—his castle of dirt, ignorance, and disease—is visited by the health officer, and so he is advised to fight to the last gasp against such inspection."

"Neither the medical practitioner nor the public health officer has any commission to go forth and find the disease, not even when an epidemic is on; no, the disease must come to the doctor. The enemy must walk past our outposts and into our camp, and ask to be attacked and arrested, before we stir hand or foot. Is not the whole thing too ludicrous for the serious consideration of anyone but the witch-doctor or medicine-man of a savage tribe? It is reminiscent of the days of burning for witchcraft or healing by incantations and charms."

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"The patient reports to the doctor, and the doctor reports to the medical officer of health, and the medical officer of health reports to the infectious disease hospital,* and then, if there is room, the ambulance is sent for the patient. Meanwhile, the disease germs have not been reporting at all, but have been going on with their business, and next day there is another case to be removed from the same house or the house next door, after 'the tale of the house that Jack built' has been run through again. Is it any wonder that we have epidemics of acute infectious diseases?"

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"The poor hard-working wife of the laborer, with all her family and housework to attend to, may be forgiven if she fails to understand even for two or three days that what she thinks is a cold or sore throat in one of her children is the beginning of a serious infectious disease, and there is no one going round inquiring for sick children in the houses, even when it is known that a severe epidemic is in progress. No; the free-born Briton must be allowed to infect his neighbors in peace, and undisturbed by any domiciliary visits of a health authority. He is not permitted to neglect the mind of his child, but he can practically neglect the body, and its care and requirements, to his heart's content."

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* "And the parson told the sexton, and the sexton tolled the bell."

"The better circumstanced classes suffer less severely from infectious disease, not because they are immune, but because they are brought less in contact with it, in the first place; and, secondly, because they are better nursed and cared for when it falls upon them."

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"As well might we send forth the privateers and letters-of-marque of Queen Elizabeth's time to fight the modern navy of our most powerful rival, as go on with our present equipment for offensive action against disease, and hope or pray for a victory.

"All honor to the wooden walls of England and to the memory of the brave men who fought within them, but their day is over; and all honor to our municipalities and medical officers of health, and the private donors who have supported our voluntary hospitals like the old privateers, and fought the good fight against disease in the face of long odds. But the day of these things is passing away. Science has shown us a better and more excellent way."

Our author then considers the evils of the present "lodge practice" system in England—probably greater there than as yet here; existing hospital systems (many of the criticisms here made do not apply to American hospitals of the better types at all); tuberculosis, in which emphatic demand for the *supervision of the infectious case*, rather than the cure of the incipient is made; and finally, a national medical service.

Whatever may be thought of the sociology or economics of Dr. Moore's plan, his knowledge of the demands of modern public health represent the very best modern teaching of our leaders in America.

H. W. Hill.

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